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ABSTRACT

The first phase of a project to design a prompting system to help semi-experienced end users to search Chemical Abstracts online, this study focused on the differences and similarities in the search approaches used by experienced users and those with less expertise. Four online searches on topics solicited from chemistry professors in small colleges--the target group for the prompting system--were conducted by each of the 12 participants, who were divided into three groups on the basis of their prior experience. Each participant received a packet of materials introducing the project, searching, and search aids, and SDC's chemistry manual, and a slide/tape presentation was shown at the time of the test. It was found that, for novice searchers, problems in interacting with the computer overshadowed all other concerns; semi-experienced searchers relied heavily on natural language searching; and experienced searchers focused on exploiting the structure of Chemical Abstracts within the capabilities of ORBIT. Problems with the search requests are discussed, as well as searching constraints and items peculiar to each searcher. Appendices include the pre-test handouts and narration for the slide/tape presentation, background on the searchers, search forms and search requests, online interaction, and searchers' comments. (RBF)

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MEASUREMENT AND IMPROVEMENT OF SUBJECT SPECIALISTS PERFORMANCE SEARCHING CHEMICAL ABSTRACTS ONLINE AS AVAILABLE ON SDC SEARCH SYSTEM

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PHASE I

TESTING ONLINE SYSTEM USE

NSF No. IST78-11407

PHASE I

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BACKGROUND

As a result of an earlier study (NSF SIS75-12748), Dr. R.F. Copeland came to the conclusion that it was more cost-effective to access the literature of Chemical Abstracts via an online system instead of subscribing to the printed version. Six chemistry professors in six small private colleges in Florida found that they could meet virtually all of their needs for Chemical Abstracts with approximately $500.00 a year of online time while the printed version cost $3,700.00 a year (at the time of the study). It was also not merely a question of replacing the printed CA with the online version - most of the schools participating in this study had cancelled their subscription to CA many years earlier. The online option meant access to the literature not previously available locally.

However, using the online system created a new set of problems. One was obviously document delivery (discussed in the report). Another was the fact that all of the people participating in the previous study were full-time college professors. Dr. Copeland's next concern centered around how to get quality search results with a limited amount of search experience or time for proper training and keeping abreast of system changes. Even when search costs were covered by the grant, the amount of searching done was barely sufficient to maintain search expertise. It was decided to embark on a project aimed at designing a prompting system to help the semi-experienced end user (and subject specialist in this case, chemistry college professors) search Chemical Abstracts online. SDC, the most favored system in the earlier study, was chosen as the vendor system for the project.

The first phase of the study focused on trying to determine what distinguished an experienced searcher from a semi-experienced searcher as a basis for deciding what types of prompts might help semi-experienced searchers

become more proficient. An assumption was made that experienced searchers were also better at exploiting system capabilities. Novices were also tested to see what similarities and differences occurred between them and the two other groups but the focus of interest was on the experienced and semi-experienced searchers. The word novice was interpreted to mean literally no previous online experience. It was felt that one quickly left the novice category and therefore any prompting geared toward their needs would rapidly outlive its usefulness. Semi-experienced was defined as the basic ability to get on and off the system and perform a literature search online on one's own.

Twelve persons were tested on four searches. We were aware that twelve was hardly a representative sample but it was better than operating on our own assumptions of how people search. The problem of finding four experienced and four semi-experienced searchers with the background we were looking for within a reasonable radius of Daytona Beach (information capital of the world!) was a major reason for the sample size. Even as it was, we did go out of the state for some of the experienced level participants. We decided twelve additional opinions about searching, SDC, Chemical Abstracts, and prompting systems would give us that much more insight into how to proceed with the second phase of the project, designing the actual prompting system. The number of variables became so prohibitive that one can hardly call the results scientific but they have indeed provided us with insights into not only search behavior, but also the whole topic of testing system use. This report will discuss both of these issues at length.

The issue of system use and misuse is only in its infancy. When it became apparent early in the study that the "test" would be variable-ridden, it was decided to go ahead anyway and try to gather as much information as possible with more of a case study rather than statistical approach.

The goal of trying to decide what in the way of prompting might help a searcher perform a better search proved to be a most useful practical guideline. Deciding empirically what constitutes a good search or a good searcher is a slippery type of evaluation to make; however, trying to determine what aids might help someone search more effectively seemed to limit this rather large topic to a more manageable problem-solving scale. That is, in a study already missing many control features, the practical concern with what constitutes a search aid provided some grounding that the question what constitutes a good search or searcher would not have given us.

Precision and recall was to be used as the measurement for evaluating the results. However, it became quite evident as the test progressed that this would be a meaningless method of evaluation. This will be discussed again later in the report.

PHASE I

Our participants were to conduct four online searches, hopefully in one sitting. More than three hours was considered to be an imposition on the time of the test participants. Also, it would have been difficult to arrange to do it in small segments since some of the testees were at considerable geographic distances. A member of the project was present during the testing to set things up, answer questions, and note comments participants made about searching, search systems, or Chemical Abstracts. This resulted in observations that would have been quite difficult to gather any other way.

THE SEARCH REQUESTS

We felt that we should solicit real search requests from chemistry professors at small colleges throughout the State of Florida. These were, after all, the people we were interested in designing the prompting system for, so their information needs should be appropriate test searches.

Approximately 150 search requests were sent out to chemistry faculty and college chemistry departments in the state. The University of Florida and Florida State University were excluded as not being representative. Very few search requests were returned. Five eventually trickled in. We solicited a few more locally. This still did not give us much to choose from. Two of the requestors said they would also be willing to participate in the study. We were curious about what differences might show up if they were to run their own searches (Novice J initiated search #2; Semi-experienced Searcher E initiated Search #3). Four of the other searches seemed "reasonable". Two of these were chosen on the basis of clarity of writing and subject content to balance out the others. The choice was still somewhat arbitrary.

There were two major disadvantages with the solicited search requests. The first was that they did not necessarily elicit or suggest techniques or features of searching, ORBIT, or Chemical Abstracts database that one might like to test. They didn't have much "resonance". A "realistic" search request does not necessarily require a wide variety of system features. One might then conclude that perhaps we don't need a wide variety of system features for the majority of our searches. While this may be true, that could constitute another study in which search requests are collected and analyzed. Our meager six hardly constitute a sufficient pool. We would have preferred searches that strongly favored the use of standard abbreviations, for instance, and then we could see how many searchers used these--or, a search that suggested searching by section number as a good approach so we could see who thought of this. Neither of these are particularly intricate or sophisticated techniques but we were curious about how many people might have used them when appropriate.

Even as it was, our search requests were a bit odd. Someone from Chemical Abstracts Service mentioned that Search #1 and Search #3 represented exceptions

in Chemical Abstracts indexing policy. In fact, several of the experienced searchers complained that CAS was not consistent in their indexing and that there were too many exceptions that only the people at Chemical Abstracts Service were aware of. Certainly this is an important issue to raise: are Chemical Abstract's indexing policies and practices appropriate to the user's needs. Once again however, this issue needs to be addressed in a more sophisticated study.

The two search requests written by test participants also proved to be unique in their own ways. No one found much if anything on Search #2. Search #3 proved to be so broad that one searcher would have given close to 1000 citations to fulfill the request and another refused to search it at all. This search raised a considerable number of subjective issues and certainly didn't enhance the value of precision and recall as an evaluative measure.

This leads into the second major problem with solicited search requests. Virtually everyone wanted to talk more to the requestors about their topics. I asked participants to try as much as possible to run the searches as they would "normally." Many said that they would not "normally" perform these searches without talking more to the requestors. Even under the testing conditions where they tried to proceed anyway many sooner or later said, "I just cannot go further without talking to the requestor."

If we had used prepared searches we could have tried to avoid this lack of clarity and ambiguity in the requests and concentrated on less subjective problems. It is doubtful however that even with planned searches the subjective element would have disappeared. In fact, there might have been more to compare if the issue of interpretation had been on a more refined level. In our study, counseling became more of an issue than system design. We will discuss the relationship between counseling the patron and search strategy in greater depth when we get to the sections on individual searchers and groups of searchers.

PREPARATION FOR THE TEST

Prior to testing we tried to come up with some hypotheses about problems users might have searching online. The more we looked at the structure of Chemical Abstracts, the more we came to the conclusion that it was a well designed tool. The indexes, appendices, teaching guides are of high quality. However, the more we studied them, the more we began to wonder if they were used the way they were designed to be used. Despite her background as a librarian in evaluating reference tools, our information scientist who had no background in chemistry was aware of the time it had taken her to familiarize herself with the structure even with the excellent workbooks and the help from the people in user education at Chemical Abstracts Service. Instead of trying to think of ways to "improve" CA, we began to think more in terms of testing for proper use or possible misuse of a sophisticated retrieval tool. The structure of Chemical Abstracts and proper vocabulary development did seem a more formidable obstacle than the command structure of ORBIT. In both cases, the big question seemed to be: Are these systems being used the way they were designed to be used?

We tried to think of ways we could improve SDC's ORBIT with a prompting system. However, we felt the mechanics of the search system would be difficult to improve upon in any significant way with our mimicomputer. While we could remind the searcher of correct form, we came to the conclusion that this could probably be done just as effectively with a cue card by the side of the terminal. Putting it online would just be a more expensive way of doing this and not necessarily any improvement in format.

We must also admit to ourselves that these systems are going to be used with or without proper training and that the end user may be completely unaware of his/her "misuse". If one uses the incorrect command, the system will either not respond or tell you you've erred. However, if you have not fully exploited

the structure of Chemical Abstracts or developed proper pre-search habits, you may walk away with seven articles, thinking that is "everything" on the topic, when there are 700. In fact, many searchers face this education problem daily with their patrons but how many who actually use these systems also share that misconception because they aren't familiar with the database they are searching?

I have gone into this discussion of concern with proper system use because it became one of the underpinnings of the first phase. The decision was made to do as much as possible within the constraints of the test to assist optimum use of the system. Instead of testing to see if people were aware of search aids, anything that could help them search was made readily available. While the experienced and semi-experienced searchers were not told how to search, major currently available resources were provided. We felt we could afford to find out if there would be any use for our prompting system, even under the best of conditions (i.e. offline aids). The information scientist also assisted whenever it was requested and made notes about the type of assistance needed.

PRIOR TO TESTING

Everyone who participated was sent a packet of material prior to the tester's arrival. This included a handout that introduced the project, searching, and search aids (Appendix A) and SDC's Chemistry manual. When she arrived, the participant was also shown an AV slide tape presentation (Appendix B).

The handouts and the AV were considered a part of the test. Material was kept to a minimum to give added emphasis to what was covered. Our handout included the absolute basics of searching but the main focus was on aids to vocabulary development. We wanted to make sure participants were aware of what was available to help them search (see earlier discussion) so all major aids from the Index Guide to the CHEMDEX file online were mentioned (CA would probably object to the absence of the Subject Coverage Manual). The SDC Chemistry hand-

out was included for two reasons. One was because it was full of examples of what the online text would look like. The other was that SDC had reprinted all of the major CA appendices that could aid the online searcher in the back of the manual, such as the list of standard abbreviations. We wanted to make sure these tables would be readily available to see if they would be used. One major flaw in our introduction and in SDC's manual was that neither possessed an index. In fact, one of the experienced searchers actually made a rough index to the SDC manual which he said he would give to us only if we informed them that he was startled they had produced such a guide without one. Another change we would have made in the introductory handout for this project is that we would have made it more eye-catching, possibly have it printed up with color illustrations so it would be more "enticing" to read.

The AV (Appendix B) was designed for the novice. We were aware at the time that there seemed to be too much to cover to bring them up to a testabel level but again we tried to keep the material to a minumum. It covers the basics of how the search system works, what the pre-search setting and a search look like. We introduced the terminal and followed a search through pre-search activity and what actually happens online. It was our hope that the AV would at least reinforce the handout in a flashy way and give the novice a rough idea of the process so they would at least feel psychologically prepared for the test. However, we must admit that no participants were particularly "computer shy." Maybe the AV helped or maybe this just wasn't a problem. The AV could have easily been broken down into two; one on the pre-search preparation, and another actually following a serach through. However, we were supposedly testing and not training so we wanted to keep introductory efforts to a goal-oriented minimum.

At the time we designed these pre-test aids we felt they would be studied

closely and we would be able to draw all kinds of conclusions from their application. That is, we could expect all test participants to have absorbed the points covered and would be able to study their use. At the same time we did not require this type of familiarity. The handouts were sent in advance with thanks for participating in the study. When the tester got on location we set up the AV. We did not demand that these aids be studied closely. We were trying to study what use was made of available resources, not how to manipulate people into using them. However, the results were somewhat discouraging. In the majority of semi-experienced and novice cases the handout was not read prior to testing. At this time the novices read or glanced over it (most tried to absorb as much as possible from it, some novices did genuinely study the handout but it was not a sufficient introduction without some experience online). But the semi-experienced class, with whom we were most concerned, paid little attention to the handouts.

The AV was designed for novices but it covered too much material for them to absorb. Several of the semi-experienced serachers picked up a few tips from it (one had not known that "$" would permit one to start a line over, some adopted a form for laying out vocabulary that was suggestive of the style in the AV, etc.). The group that paid the most attention to the handout and the AV was the experienced group who didn't need the introduction. I believe this was because they are all interested in training and were curious about our work as colleagues with similar problems.

From the standpoint of the test, this only emphasized the lack of awareness about search aids. Only one person from the semi-experienced and novice groups combined knew the difference between the Index Guide and the General Subject Headings and he was dropped from the experienced searcher category: Searcher G. The others, chemistry college professors, were not aware of the difference, nor were they aware of having made use of them previously. In

fact, the only offline aid used by the other semi-experienced searchers prior to this test was the keyword frequency list on microfiche. There is a reason why they were all familiar with this but we prefer not to explain to preserve anonymity. Suffice it to say that we doubt this is representative of widespread familiarity with that search aid. We suspect Chemical Abstracts Service might be alarmed to find out the statistics on how many chemistry college professors are not aware of the function and use of the Index Guide and the difference between this and the General Subject Headings. Also, seeming verbal awareness does not necessarily reflect practical application awareness. While we have no suggestions for how to remedy this situation past massive bibliographic instruction, we do feel that an awareness that their users don't even understand the basics of their tools can affect other decisions to not unduly refine their system when only a small percentage of their clientel will appreciate the subtleties and to all others the information will be lost.

It is important to note here that we found the people we have dealt with at CAS to be very concerned with the proper use of CA. They seem to take very seriously their responsibility to help their clientele get access to the information they need. The tendency to assume our patrons and users know more than they do is probably fairly widespread in the information community which is part of the reason we sometimes have a difficult time helping the user while we continue to design systems for our own kind who will understand the complexities and challenges of organizing information.

Perhaps it is possible to get the information one needs out of the system without a proper understanding of how the system was designed to be used. Since one can assume that virtually all semi-experienced searchers and novices conducted these searches without much understanding of the search aids available to them, one should also be able to evaluate whether this made any difference in their ability to perform successful searches.

THE TESTING SITUATION

The testees were most agreeable about participating. No one turned us down. This is perhaps surprising since the test did take several hours minimum. We tried to be as accommodating as possible which meant that we went to visit them-terminal, AV equipment, and search aids in hand. It was a bit much to ask them to conduct four searches in one sitting and each was asked to do as best as possible under the circumstances. It was agreed that we could hardly expect polished results, that it would be basically "impromtu" searching.

Certainly it was more impression gathering on how to conduct a test than an actual test. In all fairness to the participants it is important to emphasize that the searches were conducted as close to normal as possible under rather unusual and hasty circumstances and the test participants did their best "off the cuff." This seemed to be the way the semi-experienced searchers operated anyway. They viewed it as a chance to brush up and play around online. We encouraged this because we thought that was as good a way as any to find out how they used the system. The experienced searchers would hardly consider this test representative of their work. However, it does indicate their basic approaches and attitudes and their ability to manipulate the system under these circumstances.

We first discussed the project, saw the AV, then they were given the searches. Though the initial proposal called for doing the searches in a specific order and varying this for participants, the time factor was so limiting that the order of the searches became less important than getting the topics searched. The searchers preferred to pick their own order. However, everyone chose either Search #1 or #4 to begin.

Background information was collected on each searcher (Appendix C). This was usually collected after the test because the final question had to do with what they like to see on a prompting system or features they would like to see

incorporated into Chemical Abstracts. We told them it was their "wish list." By the end of the test we felt any problems, complaints, or concerns would be fresh in their minds. We had to disguise some of this background information to preserve anonymity but we will try to bring as much of it to bear on the discussion of their individual approaches to searching as we can.

We also saved all scraps of paper, the "official doodles." as we like to call them, that were used by the searchers to construct their strategies and vocabulary. Though they are interesting, we're not sure what to do with them. Many of them would not copy well and some would be impossible to transcribe. Suffice it to say that we have them and will make them available to anyone who wants to see them. Otherwise we will try to describe them in the discussion of each searcher. They range from three words to profoundly copious notes. But almost all of them have one thing in common: they were used for vocabulary development and almost never for strategy development unless that was inherent in the vocabulary "groupings".

Finally, should anyone be interested, the searchers were tested in the order listed in the appendices within their group. That is, I may have tested Novice J first, but among experienced searchers, A was tested first and D last. The order was mixed up between the three classes depending on when we could schedule them but it was J, E, A, B, C, G, H, D, K, L, M for anyone who cares to trace it this way. The next part of the report will be a discussion of the actual searching. It will consist of three parts: a section on the searching in general, a section on the searching of each group: experienced, semi-experienced, and novice, and finally a discussion of items peculiar to each searcher.

SEARCHING IN GENERAL

There were several constraints placed on the searching. One was that all four searches were done without any prior knowledge of the topics to be covered so no advance preparation could be done. One reason for this was be-

cause the searchers had varying resources available but the most important reason was because we wanted a project person to be present for their comments as they evaluated the searches and to take notes on what was done in preparation for the searches.

A second constraint was that the searches were all to be performed on CAS7276 and CHEMDEX files on SDC. When searchers mentioned that they felt another file would be more appropriate, the tester made note of it. We did not include logging on or off as part of the test because we decided it is pretty obvious when you don't log on and incentive for correcting your behavior is fairly strong.

Another constraint was the inability to talk to the requestor. We had made no provisions for this. Our information scientist, who was present for all of the tests, lacked background in chemistry so she could not "read into" the search requests for them. This helped lessen the temptation to assist them.

Another constraint was that those who had additional resources, with the exception of search aids, were not permitted to use them. Searcher B said he had a copy of one of the articles and would have looked it up manually to get a better feel for the topic (see notes, Appendix F). I might add here that there were some logistics problems with Searcher G and we were forced to end the session after he had the search requests but before he had run them online. I asked him to be sure to note anything he used to help him prepare the searches. During the later discussion he said he had looked up one of the articles. Since there were some major problems with his approach to searching in general, this did not seem to be a major influence on the results.

Probably the largest single variable affecting search results was our decision to tell searchers to "Do it as you would normally." Or at least as close as possible to "normal" as the test would permit. We wanted to encourage

searchers to use their own judgment. But "normally" not only includes personal judgment, it includes the institutional background of each searcher. This was especially true of the experienced searchers. Semi-experienced and novices were virtually all from the same background. We had thought that the emphasis on "normal" behavior would give us more honest results but that also meant considerably different levels of interpretation of what the patron really needed in the way of assistance with a search problem. We will discuss this in greater detail in the next section.

Before we move on to specific ovservations, we want to call attention to Appendix E. This appendix consists of what was actually typed in to the terminal by the searchers and the comments they made about searching. We have taken some liberties with the SDC responses but we're sure those of you who are familiar with SDC will be able to recognize the basics. This was done to keep the length of this appendex to a minimum. This appendix and the notes that go with it are actually the heart of this report. It is the reference for our comments on searching. For instance, it is obvious that if the results of three experienced searchers can fit on one page and the next semi-experienced searcher's results take two, then the experienced searchers use a certain economy of construction.

Our apologies if reading through the appendix constitutes the "drudgery and disappointment" of readership. We view this report as a way of making the record available. We are sceptical of the validity of quantifying what was done though we will try to draw it together for shorter articles that cannot contain the actual record. The liberties we (meaning us and the participants) took with this test to complete it, make us acutely aware of how subjective the results are.

This report includes fairly complete notes from the conversations the tester had with each searcher during the test (Appendix F). We have grouped them in this appendix because we thought this would facilitate the "case study" approach. It includes general and specific comments. The specific comments refer to comments

made during the actual online searching session. These have been marked in the earlier Appendix E. Reading them will call for some flipping back and forth between sections but we decided it would be easier to review the searches if we separated what the machine said from what the person said. We hope this is not too confusing.

These comments made while searching are one of the most interesting parts of the study. We had done nothing to insure that the same topics would be discussed by each searcher. This was because at the beginning of the study we had no idea of what to anticipate in the way of comments and observations. However, if we were to use this study for further research along these lines, it would include reviewing the list of the topics that were raised on this project. This list could then be used as a framework for discussion so some generalizations could be made about searcher's attitudes and approaches to online searching.

Arranging the comments into categories that reflect aspects of searching to be evaluated in a testing situation results in the following breakdown:

OUTLINE OF TOPICS COVERED VERBALLY DURING TEST

1. An evaluation of search aids. The searcher's use and opinion of the following:
   a) Index Guide
   b) General Subject Headings
   c) Subject Coverage Manual
   d) Word Frequency List
   e) Chemdex File Online
   f) SDC's Chemistry Manual
   g) Other
2. Opinion of Chemical Abstracts indexing policies.
3. House aids. That is, anything the searcher made himself to assist searching Chemical Abstracts or ORBIT.
4. Analysis of the topic:
   a) need for further clarification.
   b) usual way of preparing these topics for searching.
   c) possible use of non-online related reference works, articles, etc.
   d) other databases one would search and why.
5. Search style:
   a) relative use of controlled vocabulary vs. natural language - that is,

These all contribute to his approach. Has the searcher chosen a certain approach, or is there a lack of awareness of the options open to him? Is it his style or his lack of training and system familiarity that accounts for his preferences? Before we think of designing systems that will be more suited to the user's needs, we would have to determine what accounts for his present practices.

The concern over the issues outlined earlier varied from group to group. Since this was what we were initially interested in determining, these group variations are worth noting. We will discuss the major issues in the order of novice, semi-experienced, and experienced searchers since that seems to represent a natural progression in the learning process.

NOVICES

Not only was it difficult to try to cover all of the basics a novice should be aware of in the AV and written handout, but it was also too much material. We tried to just sit them down at the terminal and say "go to." This was followed by a blank stare. We don't think the motivation accompanying participation in this test was high enough for the novices to learn the system themselves. Also, the time limitations of the test made this impossible. Faced with early failure in the novice category, we decided it would be better to do some training and see how they responded than to give up completely.

After reviewing the handout and AV, and discussing issues like vocabulary development, all novices ran a quick preliminary search under the tester's guidance on a topic of their choice. This was done prior to handling the search requests so they would have some idea of what to do with the requests. This preliminary search was not planned for in the project but it became the quickest way to explain how the system worked, boolean operators, postings, etc.

Once the search proper began, we prompted whenever things came to a standstill to get them going again. Actually, the tester could have abandoned testing complete novices with a clear conscience. The only thing she felt she

was testing was how quickly they could absorb her perspective on searching. However, by the time the "test" was over, she felt they were as capable of handling searches on their own as the semi-experienced serachers.

There was, of course, difficulty with commands. There was also a lack of understanding of what postings were and how to use that information. It is obvious that at the beginning level these problems of how to interact with ORBIT overshadow all other concerns. However, they did accept and apply the emphasis on proper vocabulary development more readily than the semi-experienced searchers who felt they already knew what they were doing. As a result, some of the novices used more synonyms, although there was still a tendency to not anticipate varient word endings.

The major points emphasized with novices were:

1. the difference between controlled vocabulary and free text.
2. thinking of as many different words as possible to describe the same concept.
3. searching most specific concept first but not narrowing too early.
4. boolean operators.

After these points were covered, we could proceed on a question and answer basis.

As with the semi-experienced group, they assumed we could give them no help with the search request. The first time this happened the tester was quite surprised. It seemed that they felt chemistry was their field and that she couldn't possible provide them with any insight into how to interpret or break down the search request into concepts or vocabulary elements. While we preferred to not do this, it was interesting that both novice and semi-experienced searchers felt their knowledge of chemistry also extended to their ability to manipulate chemical information. (For instance, one tried to find the registry number for hydrogen bond and did not think to ask the tester why it wasn't listed).

To recapitulate: testing the novices proved to be too much of a training situation. Perhaps the most valuable observation gathered was that absorbing a few principles of searching can positively affect the quality of search results more than an emphasis on commands, that one cannot fall back on what the person

already should know about Chemical Abstracts but rather one has to introduce the tool anew from an online perspective, and that training goes quicker if disucssion is interspersed with hands-on experience as early as possible, rather than waiting until the entire process of searching is explained. However, it is our understanding that these principles are well understood by those who train and that was not to be the purpose of this study.

Their major concern was, understandably, with commands. While we hoped we could possibly bring them up to a level where their observations would be comparable with the other two groups, we decided they absorbed too much of the tester's perspective in the process.

SEMI-EXPERIENCED SEARCHERS

The semi-experienced searchers were more comfortable with commands but limited themselves to a working group. They were often unaware of even some of the less sophisticated system features. For instance, one said he'd only recently learned about the NEIGHBOR command, another mentioned that a "$" sign (allowing one to redo an entire line) was new to him. Also, they never seemed to use the hash (#) mark for single letter truncation. It would have been interesting to review the list of commands with them to find out more systematically which they were familiar with. We had assumed initially that they would know of them but perhaps not use them. However, they not only just preferred a few, they often weren't even familiar with all of them.

As an interesting sidelight, we did consistently introduce the HISTORY command to semi-experienced and novice searchers. With the exception of one, they seemed to find this quite useful. One preferred his old habit of reeling in the paper to see what he had done. While the others quickly absorbed the HISTORY command into their repertoire, they had not used it before. However, this command seems especially well suited for the semi-expereinced searchers who often did not have tight, well constructed strategies and would therefore often forget what they had already entered.

The use of truncation was not consistent. They often seemed to not anticipate possible variations in word endings. This was distinctly different from the experienced searchers who seemed to consider this for every word they might use. Also, the experienced searchers would use hash marks when they knew they would only be interested in one word and its plural. Hash marks were never used by semi-experienced searchers.

It also seemed that semi-experienced searchers consistently needed help with how to search an author and sometimes with print options. The problem of author searching was mostly a matter of form and of reminding them to not limit it, that is, to use a first name initial followed by the truncation symbol rather than a period or the whole name. Print options did not seem to be thought out in terms of objectives at that particular point in the search. That is, there seemed to be no preference for PRINT TRAIL or PRINT, and PRINT FULL was avoided after it was obvious it took too long. In other words, the main reason for printing citations online was to check if the topic was appropriate rather than for systematic restructuring of vocabulary development. Experienced searchers usually did this by just having the title, or title and author, printed out but that option did not occur to semi-experienced searchers who, would have probably been satisfied with seeing that much of the record in most cases.

None of the semi-experienced searchers ever used section numbers. Even if the searches had been more conducive to this, we don't think is is an option that would have been pursued without prompting. It is our suspicion that this is more of an education problem than that the approach is not useful. Most of them did not know <u>how</u> to search by section number. However, we are <u>not</u> sure if it would be used since the semi-experienced searchers relied heavily on free text, natural language searching. Also, standard abbreviations were never used. Again, we suspect this is lack of knowledge of them rather than preference.

The reliance on natural language searching was "all-pervasive" among the semi-experienced searchers. This was the most pronounced characteristic of their searching. We were aware of this before we began testing them. We emphasized the discussion of controlled vocabulary vs. free test because we wanted to see what use would be made of the tools available. This meant that we waited for them to use the tools but when this was not forthcoming we made a mental note that the searcher would have proceeded with virtually no use of offline aids. We then discussed the offline aids. This generated perhaps mild curiosity. (At this point, the novices tended to respond more - actually trying to use the Index Guide). It seemed that while the discussion was interesting and perhaps new to them, we had also emphasized that they could take any approach to searching that they preferred. They generally proceeded with the free text,natural language approach that they were most familiar with.

Perhaps the one exception was regarding the registry numbers. Most preferred to try to search using these. Since the CHEMDEX file was relatively new, it is also understandable that this approach was new to the searchers and required some assistance. The tendency of these searchers appeared to be that they would try searching by registry number when possible. It seemed apparent that despite their background in chemistry, they might need more assistance understanding the CHEMDEX file, a better understanding of what substances are likely to have a registry number, and how to search for them.

So if one can say that the novices were primarily absorbed in stumbling through the commands, system mechanics, and basic approach to searching using postings as a guide, the semi-experienced searcher was characterized by acute dependence on natural language searching, lack of extensive vocabulary development, lack of awareness of how to effectively use search aids in general. They used the system but they did not exploit its capabilities. This resulted in a hit and miss approach to searching. Because vocabulary was not well developed,

the searcher would encounter repeated dead ends. It appears (see Appendix E) that this often resulted from prematurely narrowing a search either by not using enough terms for a concept or combining concepts that were already quite specific. Perhaps this also indicates a lack of attention to postings as a search guide. We all know they are the only clue the system gives us of how we are doing or our probability of success with a given approach but to date this aspect of searching has some of the characteristics of reading tea leaves.

The art of reading postings (à la Mark Twain reading the currents of the Mississippi River) has not been given serious attention in training. It is possible that probability guidelines could be established to give the novice and semi-experienced searcher some clue regarding how to make effective use of psotings at various stages of search development.

EXPERIENCED SEARCHERS

Experienced searchers did not have problems manipulating the command structure of ORBIT. Either they were aware of the specific commands, or they knew what they should be able to do and had cue cards or notes to remind them of the proper ORBIT form.

Knowledge and use of offline aids was extensive. In fact, one of the major differences between the experienced searchers and the others was that the online system was peripheral to the question of how to effectively meet the requestor's needs. The structure of Chemical Abstracts, the possibility of exploiting this structure within the capabilities of ORBIT were the primary issues. This focus on the structure of CA accounts for the heavy use of offline aids since one gets virtually no assistance online with this. This was also the central concern of their "wish list" answers on the questionnaire - more help manipulating CA in an online mode. They were not only aware of what they were retrieving from the system, but they also seemed capable of evaluating what they suspected they weren't retrieving from the system.

This leads into the issue of defining the parton's information needs.

The greatest differences amongst searchers of any one group appeared in the experienced group. This was due largely to their interpretation of how to counsel the patron in their information needs and the searcher's institutional background. In one case, Searcher D, it was also due to system capabilities. Our desire to encourage searchers to "do it as you would normally" resulted in incomparable variety. It is probable that a hypothetical search situation (in addition to structured search requests) would have been a better way to structure the test. However, the differences that the effect of institutional background and usual attitudes about the role of an online search in aiding a patron had on their search style and results just points very strongly to a subjective element in searching.

Let us review this case by case.

Experienced Searcher A works for the government. After reviewing the requests he decided this was definitely "exploratory" searching. Were he to be doing these searches for his organization he would make a quick search to help define the topic further. In short, the search was a "sketch" of the topic as available online. A more comprehensive search would be the second step.

The same was basically true for Searcher B although the fact that he works in an academic setting added some additional elements to his counseling technique. The first was extreme money consciousness. Even under test conditions, time spent online was viewed as most precious. His standard way of proceeding is to do as much as possible to prepare a search and counsel a parton at minimum expense. This might mean no online search until the topic was further clarified so the patron would not be out of money with no results. The second distinctive element is how much emphasis this searcher places on counseling the patron. He seems acutely aware that the patron may not know what it is he needs and wants. Since this searcher also teaches, I suspect he has a good understanding of his clientele in this regard. Others may not have liked the way a search request was written but this searcher was curious if the requestor had a clear idea in their own

mind of what they wanted. This is not to say that this searcher was overly suspicious of his patrons. If a search is clear enough so he, the searcher, understands it, and if it is an appropriate online search, he runs it. However, if it is not clear he tries to help the patron from the standpoint of their total information needs. This also might include running a quick exploratory search to help the patron define the topic with the understanding that the topic and search can be refined after preliminary evaluations have been made. So a quick inexpensive broad sampling is the way this searcher would "normally" proceed initially and that is what we walked away with in the form of test results.

Experienced Searchers C and D were perhaps the most precision-and-recall oriented. The approaches were still quite different.

Searcher C works for Chemical Abstracts Service. He accepted the search requests at face value, especially since we were hoping he would be a good control for precision and recall. It was his aim to find what he could in the database on those topics. He tried to overlook the ambiguity in the requests and to guess the patrons subject interests. The focus was definitely on the topics and the system since he accepted the fact that access to the requestor would not be possible. Time was only a factor within the limitations of the project and cost of citations was not part of his judgment since we had not stipulated this.

Experienced Searcher D operates in a unique environment where he actually discusses the search strategy with his patrons. (See Appendix G). This indicates a whole new approach to searching facilitated by his ability to locally store his strategy. Obviously precision and recall cannot be applied comparitively when one has these kinds of system capabilities. Also, it indicates a trend towards educating the patron in the nature and structure of currently available information and information systems and using the system to enhance the counseling role rather than the searcher becoming a surrogate patron.

CONCLUSION

This report reviews the methods used to acquire information about the search process and searcher approach to online systems for the first phase of our project. The aim of the testing was more to gather opinions and thought provoking data than to run a strict, statistically reliable test. This approach was used because we found very little in the literature to give us insight into how people search to base the second phase of our study on (designing a prompting system), and because we hoped by taking a broader, issue-defining approach we might inspire others to pursue user testing in the areas of concern that emerged in our work. We hope others will do more work on system use and misuse and that our observations and data may help them decide what they are looking for and at.

It is obvious that there are only shades of grey between training and system design, but we all seem to agree that there is some optimum design for the online/user interface we should be striving for. All too often when we refer to the online/user interface we are speaking of system mechanics and forgetting the scope of the information in the database and the intent of the searcher. The mechanical system is supposed to bring these together. All three share some type of patterned approach to organizing information. Our ideas about what to do with a prompting system were altered as a result of this preliminary study. A prompting system should encourage the merging of patterns, or, you might say, the inherent logic of each. The idea of a machine recognizing an English sentence is not any more important than the searcher recognizing when he is dealing with a bonafide idea or concept. If the researcher cannot do this, how good will the work he is seeking information for be? We should be designing systems that not only compensate for searcher or database weaknesses, they should also encourage improvement in both.

A P P E N D I X A

PROJECT PRE-TEST HANDOUT

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C H E M I C A L

L I T E R A T U R E

S E A R C H I N G

O N L I N E

Handout by Maureen Corcoran, Research Associate in Information Science.
Project Director: Dr. Richard Copeland.
This material is based upon work supported by the National Science Foundation under Grant DSI 78-11407.

This handout is an introduction to the basics you will need to know to perform an online bibliographic search. It is not our intention to be sure you know everything there is to know about searching when you are done reading this handout and associated materials. If you think of something you would like to be able to do, be sure to ask if it is possible. It may already be a feature of the system but not covered in this material. Or it may be something that should be a system feature.

You will be searching the Chemical Abstracts database for the years 1972 through 1976 on a Texas Instruments terminal that will be hooked up to the System Development Corporation (SDC) computer in California via a telephone line. The master program for SDC's computer system is called ORBIT. One interacts with ORBIT when doing a search. The ideal searcher would be familiar with the capabilities of ORBIT, the structure of Chemical Abstracts, have a solid understanding of chemistry, and be able to integrate these three to exploit the bibliographic retrieval system. The ideal system would require none of these prerequistes to search it effectively. The purpose of this project is to bring the system closer to the ideal. Since the person with the background in chemistry is likely to be the primary user of the system, we want to design a prompting system to help compensate for a lack of familiarity with the mechanics of searching. We want to base its design on difficulties you, a chemist, may experience trying to use the system.

The purpose of this handout and complementary AV presentation is to give the novice a theoretical and practical introduction to online searching.

The semi-experienced searcher will see it as a review; the experienced searcher as an orientation to the project. It is not our wish to limit searching to the points covered but rather to provide a jumping off point.

The major steps involved in online searching are:

1. Clarifying the subject to be searched.
2. Identifying concepts.
3. Choosing appropriate search terms (vocabulary development).
4. Planning search strategies.
5. Translating your intentions into the command structure of ORBIT.
6. Evaluating the preliminary results.
7. Evaluating the final results.

As the searcher in this project, you will be concerned with 2 through 6. The person who wrote the search request will be responsible for the first and last steps.

The three major problems you may encounter in searching are:

1. search strategy
2. developing vocabulary to define your concepts
3. the formal command language

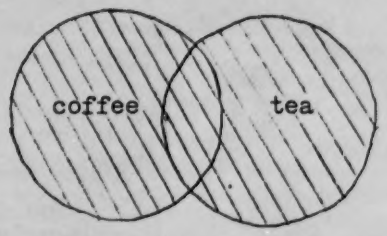
This handout will focus on how to approach these problematic areas of searching.

BASIC STRUCTURE OF COMPUTERIZED RETRIEVAL SYSTEMS

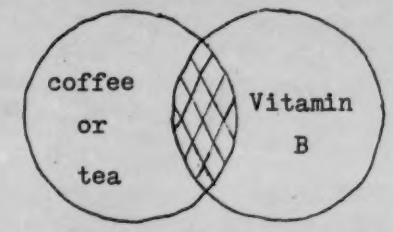
One of the major advantages to doing a search online is being able to combine ideas to form a unique topic and then generate a bibliography on that topic. While there are several ways one could set up a database for bibliographic retrieval, there is one predominant way. This involves

the basic principles of set theory. You type a term into the system, it picks out the articles associated with that term. You then form subsets by combining terms. This is done using the logical operators:

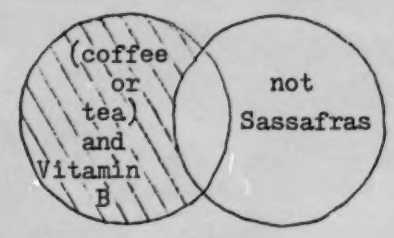
1. OR which creates a set of all terms mentioned.



2. AND which creates a set of articles having terms in common.



3. AND NOT which excludes any articles associated with that term.



Terms combined with OR serve the same function in the topic. When terms are combined with AND, the topic narrows and becomes more defined. AND NOT is used less frequently since it is generally easier to tell the system what you <u>do</u> want than to tell it what you don't want.

SEARCH STRATEGY

Developing a search strategy consists of figuring out which terms you want to combine with each other using the logical operators and in what order. When you read over your search request, you will

want to be analysing it for terms you feel are significant to that topic. Group them together whenever you feel they serve the same function. Each group will represent a concept. A concept consists of words that describe something functionally synonomous from the standpoint of the searcher. For instance, if you were interested in the analysis of powder burn from gunshot, you might use the terms "powder burn" and "wounds" in the same concept group since you would be interested in linking both of them to other terms with AND.

1. GUNSHOT AND ANALYSIS AND POWDER BURN
2. GUNSHOT AND ANALYSIS AND WOUNDS
3. 1 or 2

can also be expressed as:

1. POWDER BURN OR WOUNDS
2. GUNSHOT AND ANALYSIS AND 1

A simple search usually consists of two concepts, a complex one is rarely more than four so you may not use all of the concept groups you have established or you may use them in a variety of combinations instead of lumping them all together in one approach. Ranking their importance may help you make these search strategy decisions. It usually helps if you search

1. the most specific terms first.
2. the most important concepts first.

While you may want to map out a plan before sitting down at the terminal to search, how you decide to approach your search once you are online will depend on the number of postings you get while searching. The number of postings indicates the number of articles associated

with a given term or combination of terms. It is one of your guides to when you may want to expand or refine your search vocabulary or strategy.

There are two major approaches to searching:

1. Type all of your terms in first, making sure no search statement (a search statement is a separate message sent to the computer) contains a term you might want to separate out later. Combine them after you have established your search terminology. Example:

    1. POWDER BURN OR WOUNDS OR RESIDUE
    2. GUNSHOT OR GUNS OR FIREARMS
    3. ANALYSIS OR DETERMINATION OR TRACE ELEMENTS
    4. 1 AND 2
    5. 3 AND 4

Some searchers prefer to set up two concepts first, then combine them, then set up additional concepts as a part of their continuing search strategy, but the basic approach is still the same.

2. Combine your major terms and print out some of the articles. Find one that seems relevant and use the way it has been indexed as a basis for developing your own search vocabulary. Many searchers use this technique when they have run into problems with the first approach.

SEARCH AIDS

The search aids are printed quides to how to search on the SDC system, how Chemical Abstracts is organized, and any other reference works that can help you decide on vocabulary for your search.

Included with this handout is a copy of Chemistry, a search aid compiled by SDC. It contains an explanation of the actual computerized file with tips on how to search various elements in a record (eg. to search by author, see p. 28). There are also some valuable vocabulary aids in the appendices. Aids published by Chemical Abstracts Service include: 1) The Index Guide reflects the formal indexing policy of Chemical Abstracts. It lists cross references from one form of a term to another and includes some notes on how to approach specific subjects. 2) The General Subject Index contains the actual formal indexing terms.

We are interested in your opinion of these printed search aids. Are they useful or do you feel they're too confusing and why? Is their content and coverage the type you need or do you feel they're fine but not really necessary for searching, etc.? Take as much time as you like prior to or after searching to evaluate them.

VOCABULARY DEVELOPMENT

The words you decide to use to describe each concept constitute the vocabulary of your search. The list of words you think of without referring to the Chemical Abstracts indexes is called free text. That is, no attempt has been made to see if the database indexer used the form of word you have listed to identify articles on that topic. Unless it is also the form used by the indexers, you will only retrieve articles where the author has used that term. If you can also identify the form used by Chemical Abstracts for indexing, you may be able to retrieve even more articles on the subject. The terminology used

by the indexer is called the controlled vocabulary. You may have noticed in the gunshot example that the terms powder burn and trace elements were not connected with AND or OR. This can only be done with control terms. That is, trace elements would have to be listed in the General Subject Index to be used like this. Otherwise, the multi-word expression would have to be searched as trace AND elements.

CHEMDEX (an online chemical dictionary)

The CHEMDEX file is another vocabulary aid. It is a dictionary database of the various names and forms of names associated with specific chemical substances. The major use of the file is to obtain the registry number for a substance. The advantage to using the registry number when searching is that you don't have to anticipate all of the possible ways a substance could be named in the literature. However, it is Chemical Abstracts' policy to list the registry numbers of every substance mentioned in an article regardless of how tangential it may be to the main topic so you may end up with a lot of citations that have very little to do with your search topic. Chemical Abstracts recommends that you search a substance by its familiar names and registry number if you want to be truly comprehensive or if you are dissatisfied with the postings. However, if you just want a few good articles, you may want to skip using the registry number. If you decide to search by it, you must identify it by typing /RN after it (eg. 12345/RN).

THE NEIGHBOR COMMAND

The neighbor command is a way of looking at a section of the list of searchable terms in a database. It is an alphabetical listing and therefore called the dictionary. When you use the neighbor command, you will get a display of five terms - the two preceding and the two following the one you typed in - and the postings for each. If you want to see more on either side, you can type UP 4 or DOWN 7 (or any number up to 10). Using the neighbor command can be a source of suggestions for varient spellings of a term. It is especially helpful with authors when you don't know how their name is listed in Chemical Abstracts or the literature in general. It is also useful when you don't know why you got a limited number of postings (or none at all) for a term you feel should be pulling up more. After you have used the neighbor command, you will have to re-enter any terms you are interested in in your next search statement. This gives you a display; it is not a search command.

TRUNCATION

The truncation feature is another way of accessing similar terms with varient spellings. Truncation means you want to see all of the words that have the same spelling up to a certain point. You indicate that point with a colon. Example: COCO: could describe coco, cococos, cocoa, cocoanut, coconut, and cocoon (example not taken from Chemical Abstracts). ORBIT would list all of these terms for you. You would then have to specify which you were interested in. Or, if you want to bypass the display, you could type in ALL COCO:

The system would assume you wanted to search all of these terms. It would give you postings for the total set instead of a display.

LIMITATIONS

You may limit your search by any field in a record. For instance; if you wanted to search by author, you would type in the name of the author followed by /AU. If you are not sure of an author's name as it is listed in the database, it is wise to truncate it, eg. Copeland, R:/AU. ORBIT will then give you a display of all names beginning that way and you can the select any that you think might be the person you are intersted in. Again, ALL COPELAND,R:/AU would bypass the display.

There are two major non-subject limitations you may want to place on your topic at the end of the search. They are limiting your topic by language or date. There is no reason to get citations in other languages if you are only interested in Japanese!

To limit by language, type:

AND ENG/LA

for English (see Appendix F in SDC's Chemistry guide for other languages).

To limit by date, type:

AND FROM 76-76

This would limit your search to articles published during 1976. Substitute whatever years you are interested in.

PRINTING CITATIONS

When you want to print out articles online you have three options

available to you. They are:

PRINT

PRINT TRIAL

PRINT FULL

PRINT will give you the bibliographic information on the article. PRINT TRIAL will give you the fields that will help you select terms for subject development such as the title, keywords, and index terms. PRINT FULL will give you the full citation (not including the abstract). For the purposes of this project, PRINT TRIAL will probably be adequate since you will most likely print out articles to see if they represent the subject you are searching.

PRINT TRIAL 5 means you want to see the five most recent citations associated with the last search statement. ORBIT will automatically assume you want citations from the preceding search statement unless you specify otherwise.

PRINT TRIAL SS 2 5 means print out the five most recent citations associated with search statement 2. If you don't specify how many citations you want to see, ORBIT will automatically print out two. If you want to see more than that, you must indicate how many.

CONCLUDING REMARKS

The last resource you have to draw upon is the project person. We know we are expecting a lot from you due to time considerations of the project. There is a limit to the amount of technique anyone can absorb without a little experience online. The resource person will refresh your memory or acquaint you with any search mechanics you may be seeking as you go along.

APPENDIX B

NARRATION FOR SLIDE TAPE PRESENTATION

NARRATION FOR ONLINE SEARCHING

SLIDE TAPE PRESENTATION

VISUALS	AUDIO
GR ON /	
GR LINE /	
GR SEAR /	
GR ONLINE SEARCHING	The following is an introduction to searching computerized Chemical Abstracts./
P PERSON USING TERMINAL	Welcome to computerized literature searching. You will be helping us figure out what aids would make it easier to search the Chemical Abstracts database./
P ENTIRE ONLINE SETTING DESK, BOOKS, TERMINAL	
P CU BOOKS, TERMINAL	This slidetape presentation is aimed at familiarizing you with the basics of the system you will be using./ The important points we will be covering are also referred to in the written handout since we are not interested in testing your memory but rather the system./
P ORANGES AND CIGARETTES	Let's say you want articles about the relation between Nicotine & Vitamin C depletion./
GR PRINTOUT	Doing a literature search online can save you hours of time. By typing in your terms and building logical

relationships between them, you can produce a tailor-made bibliography on your research topic./

GR MAZE

The procedures are mildly complicated right now, but with your help we hope we can make it easier to do./

P SETTING

P BOOKS

First let's take a look at the physical setting and some of the instruments./The books you see are generally referred to as search aids. They

P BOOK SPINES

can be helpful for vocabulary development prior to, or during, your search./

They are the Chemical Abstracts Index Guide, the General Headings Index, a thesaurus, a chemical dictionary, and a general dictionary./

P LS TERMINAL

P MS TERMINAL

P CU TERMINAL

This is the terminal you will be using to do your searches./The keyboard is similar to a typewriter in most ways. However, there are a few functional differences./

GR ARROW TO CARRIAGE RETURN

First there is the carriage return. Your message is sent to the computer when you press the carriage return key. That's the signal for it to read and respond to your message./

GR PRINTOUT

If you are typing a long list of search terms and you want to use the carriage return as you normally would on a typewriter to get to the next line, just make sure the last word on the line is AND or OR before hitting the carriage return. ORBIT will give you more space to finish your message before

responding to it./

There are also some fudge factors built into the system for those of us who are not the world's greatest typists.

P CONTROL PLUS H KEY

If you have a typo and want to backspace, depress the control key located on the left side of the keyboard then hit the H key./

P $ KEY

P PRINTOUT

If you want to redo an entire line, hit the dollar sign and then the carriage return./ The computer will start the line over again - none of the information in that line will be sent./

P BREAK KEY

One more thing, if the computer is giving you a lengthy reply to one of your requests and you want to stop it, hit the break key.

Those are the mojor terminal controls that differ from a typewriter. Let's go over them./

GR CARRIAGE RETURN= SEND MESSAGE

To have the computer read your message, press the Carriage Return./

GR BACKSPACE CONTROL KEY PLUS "H"

To backspace, hold the control key down and hit the "H" key./

GR CONTINUE ON NEXT LINE

_____OR
_____AND

To continue typing on the next line, end the line with the word OR or AND./

GR REDO A LINE $ THEN CARRIAGE RETURN

To start a line over, type the dollar sign, then carriage return./

GR STOP THE INFORMATION FLOW BREAK KEY

To interrupt the computer output, hit the break key./

P DESK NEAR TERMINAL, PAPERS, BKS, ETC, PERSON AT DESK

Now let's review the preparation done before

sitting down at the terminal./

GR PICTURE OF PLANT, POSSIBLE TOXIC ASSOCIATION.

Let's say a student wants a search done for review articles on the toxicology of cannabinol, the active ingredient in marijuana./

P WORKSHEET (8 FRAMES)

Identify the major concepts of your search topic./ Begin to develop a vocabulary to express each concept./ Think of different ways to express the same concept, use the chemical abstracts indexes/or any general thesaurus or dictionary to stimulate your thinking./ Make a special note about any terms you may want to check online using the CHEMDEX file for specific chemical substances, the NEIGHBOR command or TRUNCATION. Refer to the written handout about when to use these online vocabulary aids./

Next you will want to develop a preliminary search strategy. Decide which concepts are the most important./Then think of ways to combine the concepts so you can capture the essence of your topic while you vary your approach. By doing this, if one approach is unsuccessful, or only partially successfull, you will have a back-up plan./

Think of any limitations you may want to add at the end of your search. These are things that don't directly relate to the subject such as date or language./

GR GOAL PICTURE

P KUO DOING RESEARCH

P COPELAND AT HIS DESK

Finally, set overall goals for the search./ Ask yourself/what is the requestor/going to use the information for?/

P FRANK IN CLASSROOM

GR USE NUMBER SCOPE

Approximately how many citations do I want to retrieve? Should I try to find everything in the database on the subject or just a solid sample?/

GR IDENTIFY CONCEPTS
DEVELOP VOCABULARY
DEVELOP STRATEGY
IDENTIFY LIMITATIONS
SET GOALS

To review: preparing for a search consists of identifying the concepts, developing vocabulary, developing a search strategy, specifying limitations, and setting goals. If you attend to these five pieces of business before you take to the terminal, you will be well prepared to search and it will probably cut down on the time you spend on the system./

P IMPROMPTU

GR VARIATIONS OK

However, we also realise that many people prefer a more improvised approach, using the system with a minimal amount of preparation. If this is your preference/and strikes you as more realistic, feel free to use it./ If that's the way you would approach it on your own, then by all means,/we would like to know that that is how you would do it./

GR ONLINE

P AT TERMINAL

When you sit down at the terminal, you will be ready to interact with ORBIT, the master program./

GR SEARCH FORM WITH ITEM MARKED FOR CHEMDEX

If you have any specific chemical substances that you want to search by registry number/you will want to enter the CHEMDEX file first./

GR FILE CHEMDEX

GR EXAMPLE CANNABINOL

Once you have gotten your registry numbers, you will need to switch files./ The procedure is the same.

GR FILE CAS7276

Just type in the word "file" and the abbreviation for the Chemical Abstracts file we are using for this project./

You are now ready to begin your search.

P SEARCHING

At this point the order of the steps is up to you, the searcher.

You are trying to solve a problem./

GR QUESTION MARKS

The problem is "How can I enter and combine terms to form a subset of the database on my topic?"

You may not want to use all of your concepts if you are having satisfactory results with a few of them. However, you may want to approach the same search two ways to make sure you have been thorough./

Two maxims to remember are:

GR "BE PRACTICAL"
"ALL COMPLICATIONS . . ."

"Be practical" and

"All complications are necessary evils."

With that in mind then, let's move on to the basic techniques of searching./

The steps online resemble those offline.

GR PRINTOUT

So, you enter search terms./

GR PRINTOUT

You may want to do some more vocabulary development online using the/neighbor command and truncation.

To use the neighbor command, just type the word

GR NEIGHBOR COMMAND

NEIGHBOR and your word./

GR PRINTOUT

The computer will give you a display of its dictionary. You can then select the varient forms of words listed or truncate your term./

GR TRUNCATION

Truncation is simply a way of searching all terms that have similar beginnings./

GR PRINTOUT

To get both "review" and "reviews", you can truncate by saying all review:

ORBIT will retrieve all words beginning R-E-V-I-E-W, including review and reviews.

You specify how much you want them to have in common./

GR BOOLEAN OPERATORS

Typing in terms is followed by combining them using the logical operators OR, AND, AND NOT.

OR means you want any documents with either term.

AND means you want only documents with both terms in common.

AND NOT means you do <u>not</u> want any documents with the term following AND NOT associated with it./

GR AND OPERATORS FIRST

Remember, the ORBIT program performs AND operators first so be careful that your operators express what

GR OPERATORS = INTENT ?

you intended when you use both in the same search statement./

GR PRINTOUT

When in doubt, don't use OR and AND in the same search statement./

GR PRINTOUT

You will want to evaluate your search statements as they get more involved.

Are they defining the subject you are looking for?/

Are there other combinations that could also represent your topic?

As you approach the end of your search you will also want to consider limiting the search by date or language.

To limit by date, just add AND FROM 75-76 (or whatever years you want) to your search.

To limit by language, add AND ENG-SLASH-LA./

GR MAZE

Now that you have more or less exhausted your original ideas of how to search your topic, are you satisfied with your strategy, and with the postings?

If you are not sure and want to check some of the articles, print out a few of them online./

GR PRINTOUT

You can do this by typing print trial or print full.

If you are not satisfied because the postings are too few, you may want to see the index terms in these articles to give some fresh ideas about how to call up more documents on your topic.

GR WORKSHEET

If you have too many postings, perhaps you can think of another concept to add to narrow the topic more./

That is, if you are not satisfied:

GR ALTERNATE
EXPAND
REFINE

1. Pursue an alternate search strategy.
2. Expand the vocabulary using a thesaurus or index terms of relevant articles.
3. Refine your search by adding another concept./

P HAPPY SEARCHER

If you are satisfied, great!

Tell the project person you have finished and he or she will finish the record keeping on the system.

Feel free to ask the resource person for reminders of procedures when you get bogged down.

We want to know where a prompting system would be of assistance to you so we are very interested in your questions and observations as you use the system./

APPENDIX C

SEARCH REQUEST FORMS AND SEARCH REQUESTS

SEARCH REQUEST FORM

Name:_____ Date:_____

Position or title:_____ Work Phone:_____

Address:_____ Home phone:_____

Status:_____faculty _____grad. ____undergrad. (yr.____) ____other (specify)_____

1. Which indexes, including Chemical Abstracts, if applicable, do you use routinely for research? (Please list in order of use.)

_____

_____

2. Are any of the Chemical Abstracts printed tools available locally? ___yes ___no
If yes, which?

___CA Sections, weekly (___printed ___microform)

___CA Volume Indexes (___printed ___microform)

___CA Collective Indexes (___printed ___microform)

___CA Index Guide

___Don't recall names, but it is available

___Other (please specify)_____

If no, how do you access it?

___Go to another school (please specify)_____

___Use the online service.

___Use the online service and sections with abstracts.

___Don't have occasion to use it.

___Other (please specify)_____

3. Have you ever had an online bibliographic search done before?

__No, this is the first time.

__Yes, once or twice.

__Yes, several times.

__Yes, regularly.

4. Have you ever conducted your own searches?

___No, never.

___Yes, once or twice.
Vendor:_____
Data base:_____

___Yes, I do my own searching.
Preferred vendor:_____
Databases:_____
_____

5. How do you get information in your field? (Please rank in order of importance.)

___Colleagues
___Teachers
___Journal subscriptions
___My college library
___Other libraries (specify)_____
___Conferences
___Online searching
___Other (please specify_____

SEARCH DESCRIPTION

Since several people from differing online backgrounds will be performing your search, your description of the subject should be as complete as possible. Assume your searcher is unfamiliar with your field and knows nothing of your research objectives.

1. Please write a full description, in sentence form, of the subject to be searched. Be specific, define terms which have special meaning. Include names or descriptive terms for specific items, ideas, processes, methods, or techniques if relevant to your topic. Append a list to your narrative of any synonyms, closely related terms, or alternate spellings.

2. If you were to write a paper on this topic, what would you entitle it?

3. Are there any authors you know of whose work is of special interest to you in this field? Complete names, if known, are helpful.

4. Please list the complete citations of two or three of the most useful articles, books, etc., on your topic, if known.

5. Which of the following statements best characterizes the type of search you want done?

___A few good articles (around 10).

___A working bibliography of 25 to 35 citations.

___A comprehensive search which could run between 75 to 100 citations.

RESTRICTIONS OR LIMITATIONS (optional)

6. Language:____ English only____ any language____ other (specify):_____

7. Dates (i.e. nothing before 1975):_____

8. Geographic (i.e. only interested in research done in the United States):

_____

9. Other restrictions or limitations (these may be used to narrow the search if too many citations are found in the data base):

_____

_____

INFORMATION NEED

10. Check all applicable blanks which most accurately describe the ultimate purpose of the search results:

___Research project

___Grant proposal

___Seminar

___Class project

___Term paper

___Thesis (Master's)

___Dissertation (Doctoral)

___Bibliography for publication

___Personal bibliography

___Patent search

___Instruction or teaching

___Other:_____

11. Do you want to particpate in the searching phase of our project?

___Yes ___No

I will be undertaking a manual search through the CA indexes.

Please return completed search request form to:

Maureen Corcoran
Dept. of Chemistry
Bethune-Cookman College
Daytona Beach, Florida 32015

SEARCH #1

Title:

Induced Electron Transfer in the Reaction of Ferricyanide with (Methyl Pyridinium) pentaamminecobalt(III) Complexes.

Search Description:

We are interested in studying the type of reactions known as induced electron transfer reactions. In this type of reaction, an oxidizable ligand is coordinated to a transition metal cation such as Cobalt(III). An external oxidizing agent such as Cerium(IV) or Ferricyanide acts to oxidize the coordinated ligand by a one electron transfer process. The metal to which the ligand is coordinated accepts the second electron in the overall two electron process. Hence, the action of the external oxidizing agent results in the reduction of the transition metal cation. We are interested in utilizing substituted methyl pyridinium salts as the oxidizable ligand, coordinating it to the pentaamminecobalt(III) moiety, and oxidizing the ligand to an N-methylpyridone with concomitant reduction of the cobalt.

Known Authors:

Henry Taube

Known Citations:

"Electron Transfer Reactions of Complex Ions in Solution" by H. Taube, Academic Press, N. Y., 1970.

R. A. Abramovitch and A. R. Vinutha, J. Chem. Soc., 1971, 131-136.

Type of Search:

A working bibliography. Any language.

Information Need:

Research project; grant proposal; bibliography for publication.

SEARCH #2

Title:

Equilibrium and Mass Transfer of CO in salt water media and Associated Chemical Reactions.

Search Description:

I would like to have done a search done on the determination of equilibrium constants of CO for its oxidation to CO2 in salt water media and any biological algae, bacteria etc that might also be involved. I would like to how (sic: know how) pH, temptrature, ionic strength of the water, pressure affect the equilibrium constant for the above. I would also like to get any data on concentrations of CO in terms of mass transfer overtones in salt water.

Type of Search:

A comprehensive search.
Any language.
Nothing before 1910.

Information Need:

Research project; grant proposal; personal bibliography; instruction or teaching.

SEARCH #3

Title:

Polymeric Reagents (Polymer-bound Biochemical Reagents).

Search Description:

Research involves the snythesis and reactions of polymer-bound reagents, coenzymes, and substrates. Polymers generally involve copolymers of styrene and divinyl benzene (1-2%). Attachment of pendent groups via displacement reactions on chloro-methyl polystyrene (or copolymer). Possible groups to be attached are coenzymes or closely related model compounds: thiamine or thiazole, pyridoxal. Reactions to be studied by use of such polymeric reagents include: aldol-type condensations, decarboxylations, and transaminations.

Known Authors:

Nechers, D. C.; Lenzhoff, A.; Patchornik, A.; Wroebel, H.

Know Citations:

Solid Phase Synthesis, by Nechers & Blossey, D.H.&R. 1975.

Type of Search:

A comprehensive search.
Any language.
1972 to present.

Information Need:

Grant proposal; personal bibliography.

SEARCH #4

Title:

Hydrogen Bounding in (Highly Hindered) Alcohols.

Search Description:

Interested in the strength of bonding, the species formed (monomer, dimer, higher polymers), and the equilibrium constants when hydrogen bond interactions occur between alcohol molecules (R-O-H type interactions). Experimental techniques commonly used include proton and carbon-13 nuclear magnetic resonance (chemical shifts, linewidths, and relaxation times), infrared absorbtion spectrophotometry, dielectric constant measurements (dipole moments), and heats of solution and/or dilution. Most often, alcohols are dissolved in inert solvents such as CCl4 (?), C6H14, etc.

Known Authors:

E. D. Becker, CNR rao, JD Bernal, E.R. Lippincott, J.A. Pople, M. Hanna, A.L. McClellan, ASN Murthy.

Known Citations:

Pimentel and McClellan, Hydrogen Bond, Freeman (1960).
Dodd and Stephenson, Hydrogen Bonding, Pergamon (1959).
(both old)

Type of Search:

A comprehensive search.
Any language.
1970 to present.

Information Need:

Research project; thesis (Master's); instruction or teaching.

APPENDIX D: BACKGROUND INFORMATION ON PHASE I SEARCHERS

Some of this information has been generalized to protect anonymity (Section C is verbatum however). The background does not necessarily reflect the participant's current occupation. However, all participants are currently teaching, researching, or practicing in the field of chemistry or are information professionals who focus on access to the chemical literature.

The first page is a copy of the form used to collect this information. This is followed by a breakdown by question.

BACKGROUND INFORMATION ON PHASE I SEARCHERS

The following information will be eliminated from the NSF report:

Name: Address:

Position:

Phone Number:

Social Security Number:

A. The following information will be a part of our report:

1. What is your subject background? For example, undergraduate degree in physics, graduate degree in organic chemistry, etc. Informal background welcome too.

2. Which subject areas of chemistry do you feel most comfrotable with?

3. Which subject areas of chemistry do you feel least comfortable with?

4. How often do you use the printed version of Chemical Abstracts?

5. How often do you use the online version of Chemical Abstracts?

6. Have you had any formal bibliographic instruction? For example, a course in how to access chemical literature, a Master's in Library Science, etc.

7. Have you had any informal bibliographic instruction? For example, worked in a library as a reference assistant, did library work for a professor. (No need to answer this if your current position indicates ample library experience!)

B. This section applies only to those who have searched online prior to this project:

1. How long have you been conducting online bibliographic searches?

2. Which vendor are you most comfortable with? Which system did you first learn to search on? Do you search other systems? Which?

3. Have you attended any vendor training courses? Which vendor(s)? Beginning or advanced level, or both?

4. Have you attended Chemical Abstracts Service training courses?

5. When you search, is the information for your own use? If so, how often is this the case?

6. Do you conduct searches for other people? If so, how often? Are they present while you search?

C. This section applies to everyone! If you could have any three things on a prompting system to help you search Chemical Abstracts online, what would they be? (in oder of desirability)

ANALYSIS OF BACKGROUND INFORMATION ON PHASE I SEARCHERS

A.

1. What is your subject background?

Experienced	Searcher A	Advanced degree in Physics Teacher of Applied Physics (not current occupation) Editor of physics journal
	Searcher B	Undergraduate degree in Chemistry Advanced degree in Library Science
	Searcher C	Advanced degree in Physical Chemistry Years at Chemical Abstracts Service
	Searcher D	Undergraduate degree in Chemical Engineering Courses in Library Science
Semi-experienced	Searcher E	Undergraduate degree in Chemistry Advanced degrees in Chemistry and Organic Chemistry
	Searcher F	Undergraduate degree in Chemistry Advanced degree in Inorganic Chemistry
	Searcher G	Advanced degrees in Chemistry and Library Science
	Searcher H	Advanced degree in Organic Chemistry
Novice	Searcher J	Undergraduate degree in Chemical Engineering Advanced degree in Physical Chemistry
	Searcher K	
	Searcher L	Undergraduate degree in Chemistry and Physics Years as analytical chemist
	Searcher M	Undergraduate degree in Chemistry and Biology Advanced degree in Chemistry and Clinical Chemistry

A.

2. Which subject areas of chemistry do you feel most comfortable with?

Experienced	Searcher A	Inorganic, physical, nuclear
	Searcher B	Organic, polymers
	Searcher C	Inorganic and coordination
	Searcher D	Organic and hi-polymer
Semi-experienced	Searcher E	Organic and biochemistry
	Searcher F	Analytical; inorganic
	Searcher G	Physical
	Searcher H	Organic; biochemistry
Novice	Searcher J	Physical
	Searcher K	
	Searcher L	Qualitative and quantitative analytical chemistry
	Searcher M	Analytical; physical; biochemistry

3. Which subject area of chemistry do you feel least comfortable with?

Experienced	Searcher A	Organic; biochemical
	Searcher B	Physical, quantum
	Searcher C	Biochemistry
	Searcher D	Inorganic; biochemistry
Semi-experienced	Searcher E	Inorganic
	Searcher F	Physical; organic
	Searcher G	Inorganic
	Searcher H	Inorganic; physical
Novice	Searcher J	Nomenclature; qualitative analysis
	Searcher K	
	Searcher L	Organic
	Searcher M	Organic

A.
4. How often do you use the printed version of Chemical Abstracts?

Experienced	Searcher A	Backup for online searches. Use for word usage, abbreviations, registry, numbers, frequency of usage, etc.
	Searcher B	Heavily
	Searcher C	Weekly
	Searcher D	I use the index, otherwise monthly or less.
Semi-experienced	Searcher E	Once a week.
	Searcher F	Once or twice a year.
	Searcher G	At least twice a month.
	Searcher H	Maybe once a year.
Novice	Searcher J	Used to use it quite a bit; now isolated from a copy.
	Searcher K	
	Searcher L	Perhaps 15-20 times a year.
	Searcher M	Seldom.

A.

5. How often do you use the online version of Chemical Abstracts?

Experienced	Searcher A	Several times a week.
	Searcher B	Moderately.
	Searcher C	Weekly.
	Searcher D	Daily.
Semi-experienced	Searcher E	Once every six months.
	Searcher F	Once or twice a year.
	Searcher G	Presently very limited access; previously daily exposure.
	Searcher H	About a dozen times a year.
Novice	Searcher J	Never.
	Searcher K	
	Searcher L	Never used.
	Searcher M	Never.

6. Have you had any formal bibliographic instruction? For example, a course in how to access chemical literature, a Master's in Licrary Science, etc.

Experienced	Searcher A	None
	Searcher B	Teach access to chemistry literature.
	Searcher C	Teach access to chemistry literature.
	Searcher D	Courses in library science.
Semi-experienced	Searcher E	No
	Searcher F	No
	Searcher G	Teach access to chemistry literature.
	Searcher H	None
Novice	Searcher J	Survey courses in chemical literature.
	Searcher K	
	Searcher L	No
	Searcher M	No

A.

7. Have you had any informal bibliographic instruction? For axample, worked in a library as a reference assistant, did library work for a professor. (No need to answer this if your current position indicates ample library experience!)

Experienced	Searcher A	Completely self-taught.
	Searcher B	Works in information profession.
	Searcher C	Works in information profession.
	Searcher D	Works in information profession.
Semi-experienced	Searcher E	No
	Searcher F	Only hand experiences.
	Searcher G	Works in information profession.
	Searcher H	Many literature searches.
Novice	Searcher J	Advanced degree
	Searcher K	
	Searcher L	No
	Searcher M	No

B. This section applies only to those who have searched online prior to this project.

1. How long have you been conducting online bibliographic searches?

Experienced	Searcher A	Since 1971.
	Searcher B	Since 1976.
	Searcher C	Since 1977.
	Searcher D	Since 1976.
Semi-experienced	Searcher E	1 hour over one year.
	Searcher F	Since 1975.
	Searcher G	Since 1971.
	Searcher H	Since 1977.

2. (a) Which vendor are you most comfortable with?

Experienced	Searcher A	Lockheed's Dialog
	Searcher B	Lockheed is the only vendor I use and C. A. the only files.
	Searcher C	No preference
	Searcher D	SDC
Semi-experienced	Searcher E	SDC
	Searcher F	SDC
	Searcher G	SDC
	Searcher H	SDC

B.
2. Continued

(b) Which system did you first learn to search on?

Experienced	Searcher A	DOE's Recon, which began as Dialog
	Searcher B	Lockheed
	Searcher C	Dialog
	Searcher D	SDC
Semi-experienced	Searcher E	SDC
	Searcher F	SDC
	Searcher G	Battelle
	Searcher H	I have used SDC only.

(c) Do you search other systems? Which?

Experienced	Searcher A	Yes, SDC's "Orbit"; BRS; Informatics' "Recon IV"; NY Times' "Ballots"; NASA's "Recon"; RLIN's "Ballots"; NLM's "Elhill"; the local batch system on many of the same databases.
	Searcher B	Lockheed
	Searcher C	Yes, BRS, SDC, LRS
	Searcher D	Yes, LRS
Semi-experienced	Searcher E	No
	Searcher F	Lockheed is used by our library and works well.
	Searcher G	Lexis
	Searcher H	SDC only

B.

3. Have you attended any vendor training courses? Which vendor(s)? Beginning or advanced level, or both?

Experienced	Searcher A	DOE's Recon - Advanced Lockheed's Dialog - beginning BRS - beginner Biosis (on bio abstracts)
	Searcher B	Beginning and advanced Dialog workshops Advanced in chemical files
	Searcher C	LRS, SPC - beginning and advanced BRS - beginning
	Searcher D	SDC, CAS, DERWENT-WPI, TITUS LRS, PREDICAST FILES
Semi-experienced	Searcher E	No
	Searcher F	None
	Searcher G	SDC
	Searcher H	SDC - one beginning workshop

4. Have you attended Chemical Abstracts Service training courses?

Experienced	Searcher A	No
	Searcher B	Yes
	Searcher C	Yes
	Searcher D	Yes
Semi-experienced	Searcher E	No
	Searcher F	No
	Searcher G	No
	Searcher H	No

B.

5. When you search, is the information for your own use? If so, how often is this the case?

Experienced	Searcher A	Only occasionally, say 5%.
	Searcher B	No
	Searcher C	No
	Searcher D	Very seldom.
Semi-experienced	Searcher E	Yes, usually.
	Searcher F	Yes - always. Well, done some online searches for faculty members, but not many.
	Searcher G	Both
	Searcher H	About half the time.

6. Do you conduct searches for other people? If so, how often? Are they present while you search?

Experienced	Searcher A	Half the time, the requestor is present, either because they await the print or because they are needed to refine the search question in the light of some test output. I average two searches for others each day.
	Searcher B	Yes and they are not present when I search due mostly to their own choice. I search whenever asked and it varies but I would say I use computer files moderately.
	Searcher C	Yes, usually patron not present.
	Searcher D	Normally for others; 2 or 3 times daily. Requestor present less than 20% of the time.
Semi-experienced	Searcher E	Sometimes for students.
	Searcher F	Not often. I prefer that they be present.
	Searcher G	Used to do.
	Searcher H	Yes. About once every two months. Sometimes they are present.

C. This section applies to everyone! If you could have any three things on a prompting system to help you search Chemical Abstracts online, what would they be? (In order of desirability)

Experienced Searcher A
I would prefer that Chemical Abstracts add multiple subject classification assignments, and that they use group names in indexing (eg. polyaromatic hydrocarbons; heterocyclic nitrogen cpds (ed. note: not sure if that is the correct spelling, cannot tead the handwriting); how to do that with prompting, I don't know. As for prompting, I don't know what a prompter can do that a handy manual alongside the terminal can't do. Perhaps abbrev. need reminders; perhaps the relation of section codes and index words (eg. Section 4 is Toxicology). But too many editorial practices are not codified by CAS and so can't be entered into a prompter.
Sorry, I am a novice in prompting and can't guess what you think could go in.

Experienced Searcher B
1. Prompt for nomenclature.
2. Prompt for substructure searching.
3. Prompt for new features of the system.

Experienced Searcher C
1. Automatic transfer of dictionary retrieval to document file as search statement.
2. Automatic broader-narrower terms.

Experienced Searcher D
1. Subject tie-in reminder.
   For example: Terms used show direct link to volume index headings.
2. Process synonyms and abbreviations.
   For example: Terms production, manufacture, synthesis would cue in other synonyms and abbreviations used in CA data bases.
3. Word frequency by CA Section Number.

Semi-experienced Searcher E
No comments.

Semi-experienced Searcher F
1. How to use OR commands, i.e., the effect of an OR command in a particular database.
2. Related to the above, a general statement on how a computer gives priorities to commands.
3. Ways to discover misspelled index terms or title terms without looking through the whole list of search terms.

Semi-experienced Searcher G
1. Better subject analysis of current issues on Condensates.
2. More consistency in indexing.
3. Use of WLN as a tool in searching CA.

Semi-experienced Searcher H
1. My own notes.
2. SDC Manual.

Section C - Continued

Novice J
Superimpose more of CA structure, search procedures appropriate to CA.

Novice K

Novice L
1. Command language, use of and/or, colons, etc.
2. Vocabulary aids, such as use of registry numbers and use of Chemdex, truncation, etc.
3. Interpretation of output symbols and abbreviations.

Novice M
1. A person to help searching.
2. A machine prompt to lead you through the steps.
3. A complete handbook that describes as much as possible about the system.

APPENDIX E

ONLINE INTERACTION

SEARCH #1

Experienced Searcher A

```
SS 1  FERRICYANIDE AND ELECTRON; FD FERRICYANIDE AND TRANSFER; FD 1 OR 2
ss 1  pstg 64
ss 2  pstg 57
ss 3  pstg 101
SS 4  PRT TI SS 1
SS 4  PRT TI SS 2
SS 4  PYRIDINIUM AND 3
      no match
SS 4  PYRIDINIUM
      pstg 1255
SS 5  3 AND 4
      no match
SS 5  4 AND FERRICYANIDE                          backspacing
      pstg 4
SS 6  PRT OFFLINE                                 comment (note 1)
```

Experienced Searcher B

```
SS 1  ELECTRON AND TRANSFER; FD FERRICYANIDE; FD COBALT; FD ALL COMPLEX:
ss 1  pstg 2916
ss 2  pstg 559
ss 3  pstg 24757
ss 4  pstg 65929
SS 5  1 AND 2 AND 3 AND 4 AND 5
      pstg 3
SS 6  PRINT TRIAL
SS 6  PRT OFFLINE
```

Experienced Searcher C

```
SS 1  ELECTRON EXCHANGE REACTIONS AND COBALT AND AMMINE#    comment (note 2)
      no pstg (electron exchange reactions)
      mm (ammine#) (2)
      1 ammine
      2 ammines
      specify numbers, all, or none
      ELECTRON EXCHANGE REACTION
      no pstg (ammine#)
      no match
SS 1  ELECTRON EXCHANGE REACTION
      pstg 1534
SS 2  1 AND COBALT AND ALL AMMINE#                backspacing
      pstg 6
SS 3  PRT FU 3
SS 3  (1 OR ELECTRON EXCHANGE REACTION CATALYSTS OR KINETICS OR ELECTRON EXCHANGE REAC
      TION) AND COBALT AND ALL AMMINE#
      pstg 13
SS 4  3 AND NOT 2
      pstg 7
SS 5  PRT AN TI AU IT
SS 5  ELECTRON AND (EXCHANGE OR TRANSFER) AND COBALT AND ALL AMMINE#  comment (note 3)
      pstg 52
SS 6  5 AND NOT 3
      pstg 39
SS 7  PRT AN TI AU IT
SS 7  PRT OFFLINE  SS 5
```

SEARCH #1

Semi-experienced Searcher E

```
SS 1  FILE CHEMDEX
SS 1  C5H22N601CO
      np
SS 1  C5H22N601CO/MF
      np
SS 1  METHYLPYRIDINEPENTAAMINCOBALT(3+)
      np
SS 1  METHYLPYRUIDINE:                          backspacing
      np
SS 1  METHYLPYRIDINE:
      pstg 1
SS 2  PENTAAMINCOBALT(3+)COMPLEXES:
      np
SS 2  PENTAAMINCOBALT:                          backspacine
      np
SS 2  FILE CAS7276
SS 1  ELECTRON EXCHANGE
      np
SS 1  REDOX REACTION:
      mm 2
        1 redox reaction/it
        2 redox reaction catalysts/it
      ALL                                       prompted (note 4)
      pstg 1148
SS 2  LIGAND:
      mm 12
      1 OR 9 OR 11                              backspacing - prompted (note 5)
      pstg 6919
SS 3  COBALT(3+)
      np
SS 3  METHYLPYRIDINE
      pstg 336
SS 4  COBALT(III)                               comment (note 6)
      np
SS 4  COBALT
      pstg 24757
SS 5  TAUBE,H:/AU
      np
SS 5  TAUBE, H:/AU
      mm 5
      1 OR 4
      pstg 45
SS 6  ABRAMOVITCH, R:/AU
      mm 3
      ALL
      pstg 70
```

(Continued next page.)

SEARCH #1

Semi-experienced Searcher E - Continued

```
SS 7  HIS                                                  prompt (note 7)
SS 7  1 AND 2 AND 3 AND 4                                  backspacing
      none
SS 7  2 AND 3 AND 4
      pstg 1                                               prompt (note 8)
SS 8  1 AND 3 AND 4
      none
SS 8  PRT FULL SS 7
SS 8  3 AND 5
      none
SS 3  4 AND 5
      pstg 4
SS 9  PRT TRIAL SS 8  4                                    backspacing
SS 9  PENTAAMMINE COBALT
      np
SS 9  COBALT PENTAAMMINE:
      np
SS 9  COBALT AMMINE:
      np
SS 9  4 AND 6
      none
SS 9  HIS
SS 9  1 AND 6
      none
SS 9  OXIDATION
      pstg 25635
SS 10 1 AND 2 AND 4 AND 9
      pstg 2
SS 11 PRT TRIAL
SS 11 LIGAND OR LIGANDOPENTAAMINECOBALT OR LIGANDS
      pstg 6918
SS 12 11 AND 3 AND 4
      pstg 1
SS 13 1 AND 11 AND 4 AND 9
      pstg 2
SS 14 7 OR 8 OR 10
      pstg 7
SS 15 7 OR 8 OR 10 OR 11 OR13 OR 7
      np(11 OR13 )
      pstg 7
SS 16 15 OR 11 OR 13
      pstg 6922
SS 17 7 OR 8 OR 19 OR 12 OR 13 OR 14
      pstg 7
SS 18 PRT OFFLINE
```

SEARCH #1

Semi-experienced Searcher F

```
SS 1  ELECTRON
      pstg 67217
SS 2  1 AND TRANSFER
      pstg 2916
SS 3  2 AND TRANSFER
      pstg 2916
SS 4  2 AND INDUCED
      pstg 72
SS 5  PENTAMMIN3
      no pstg
SS 5  PENTAMMIN#
      pstg 8                                  comment (note 9)
SS 6  COBALT: AND 5
      pstg 6
SS 7  PRINT TRIAL
SS 7  HIS                                     prompt (note 10)
SS 7  6 AND 4
      no pstg
SS 7  TAUBE, H:/AU                            prompt (note 11)
      mm 5
      1,4
ss 7  pstg 45
SS 8  7 AND4
      no pstg
SS 8  7 AND 4
      no match
SS 8  PRT OFFLINE SS 4
```

Semi-experienced Searcher G

```
SS 1  ELECTRON TRANSFER
      no pstg
SS 1  ELECTRON EXCGANGE
      no pstg
SS 1  ELECTRON ECHANGE
      no pstg
SS 1  ELECTRON:
      mm 84
      ALL
ss 1  pstg 79861
SS 2  ELECTRONN
      pstg 2
SS 3  ELECTRON: AND ECH
SS 3  E1
      pstg 856
SS 4  1 AND EXCHANGE
      pstg 3668
SS 5  13408-62-3/RN AND 4
      pstg 22
SS 6  31011-67-3/RN  AND 5
      no match
```

(Continued next page)

SEARCH #1

Semi-experienced Searcher G - Continued

```
SS 6  31011-67-3/RN AND 4
      no match
SS 6  33248-49-6/RN AND 4                          backspacing
      no match
SS 6  44236-77-3/RN AND 4
      pstg 1
SS 7  PRINT
SS 7  ABRAMOVITCH, $
      ALL ABRAMOVITCH, R:
      no pstg
SS 7  ABRAMOVITCH, R:/AU
      mm 3
      ALL
ss 7  pstg 70
SS 8  7 AND 4
      no match
SS 8  7 AND ELECTRON
      no match
SS 8  VINUTHA,A/AU
      no pstg                    line garbage (V INUTHA,A:/AU)
SS 8  VINUTHA, A:/AU
      no pstg
SS 8  TAUBE, HENRY/AU
      pstg 27
SS 9  9 AND ELECTRON
      pstg 263
SS 10 8 AND ELECTRON                               comment (note 12)
      no pstg (38) line garbage
      no match
SS 10 METHYL PYRIDINIUM SALT$
      METHYL AND PYRIDINIUM AND SALT:              prompt (note 13)
      mm (salt) 47
      ALL
SS 11 10 AND ELECTRON
      error reenter input
      10 AND ELECTRON
      pstg 1
SS 12 PRINT                                        comment (note 14)
SS 12 ERASEALL
```

Semi-experienced Searcher H

```
SS 1  OXIDATION
      pstg 25635
SS 2  COBALT
      pstg 24757
SS 3  COMPLEX:
      mm 77
      ALL
ss 3  pstg 65929
```

(Continued next page)

SEARCH #1

Semi-experienced Searcher H - Continued

```
SS 4  1 AND 2 AND 3
      pstg 226
SS 5  PENTAMMINECOBALT
      pstg 1                                    comment (note 15)
SS 6  PENTAMMINE:
      mm 6
      4
ss 6  pstg 1
SS 7  PRINT 1 SS 6                              comment (note 16)
SS 7  14
      pstg 6708
SS 8  PYRIDINIUM
      pstg 1255
SS 9  1 AND 2 AND 3 AND 8
      no match
SS 9  2 AND 3 AND 8
      pstg 5
SS 10 PRINT 5 SS 9                              comment (note 17)
SS 10 FERRICYANIDE
      pstg 559
SS 11 1 AND 2 AND 3 AND 10
      pstg 4
SS 12 PRINT 4 SS 11                             comment (note 18)
SS 12 INDUCED
      pstg 28372
SS 13 ELECTRON
      pstg 67217
SS 14 TRANSFER
      pstg 27369
SS 15 12 AND 13 AND 14
      pstg 72
SS 16 15 AND 2
      pstg 4
SS 17 PRINT 4 SS 16
SS 17 TAUBE, HENRY/AU
      pstg 27
SS 18 17 AND 2
      pstg 1
SS 19 PRINT 1 SS 18
SS 19 17 AND 15
      no match
SS 19 17 AND 1 AND 3
      pstg 3
SS 20 PRINT 3 SS 19
SS 20 7 OR 12 OR 17 OR 19
      pstg 34951                                comment (note 19)
SS 21 6 OR 11 OR 16 OR 18 OR 19                 backspacing
      pstg 13
SS 22 PRT OFFLINE
```

SEARCH #1

Novice J

```
SS 1  ELECTRON TRANSFER                                    prompt (note 20)
      np
SS 1  ELECTRON AND TRANSFER
      pstg 2916
SS 2  COORDINATION CHEMISTRY
      np
SS 2  COORDINATION AND LIGANDS
      pstg 461
SS 3  OXIDIZABLE LIGAND
      np
SS 3  METHYL PYRIDINIUM
      np
SS 3  OXIDIZABLE AND LIGAND
      none
SS 3  TRANSITION AND LIGAND
      pstg 693
SS 4  1 AND 2 AND 3
      pstg 2
SS 5  PRINT TRIAL
SS 5  PRT OFFLINE
```

Novice K

```
SS 1  FILE CHEMDEX                                         prompt (note 21)
SS 1  FERRICYANIDE
      pstg 1
SS 2  PRINT FULL                                           prompt (note 22)
SS 2  N-METHYPERIDONE
      no pstg
SS 2  METHYLPERIDONE OR N-METHYLPERIDONE
      no pstg
      no pstg
SS 2  PENTAAMINE COBALT:
      no pstg
SS 2  COBALT
      pstg 1
SS 3  PRINT
SS 3  COBALT ORor COABLT(III)                              backspacing problems
      search syntax error.  search aborted
SS 3  FILE CAS7276
SS 1  ELECTRON AND TRANSFER AND (FERRICYANIDE OR 13408-62-3/RN)   backspacing
      pstg 34
SS 2  PRINT TRIAL 5
SS 2  PENTAAMINE COBALT
      no pstg
SS 2  PENTAAMINE AND COBALT
      pstg 4
SS 3  PRINT 4
SS 3  PENTAAMINE AND COBALT(3+)
      search syntax error.  search aborted.
```

(Continued on next page)

SEARCH #1

Novice K - Continued

```
SS 3  PENTAAMINE
      pstg 8
SS 4  COBALT(3+)                                  ]     prompt (note 23)
      search syntax error.  search aborted        ]
SS 4  COBALT (3#)                                 ]
      search syntax error.  search aborted        ]
SS 4  COBALY#3+#                                  ]     backspacing
      no pstg                                     ]
SS 4  COBALT#3+#                                  ]
      no pstg                                     ]
SS 4  HIS
SS 4  1 AND 2
      no match
SS 4  NBR PENTAAMINE
      5 DOWN
SS 4  METHYLPYRIDINE
      pstg 336
SS 5  1 AND 2 AND 4
      no match
SS 5  306-53-6/RN
      pstg 17
SS 6  COBALT
      pstg 24757
SS 7  1 AND 5 AND 6
      no match
SS 7  1 AND 6
      pstg 4
SS 8  PRINT 4
SS 8  PENTAMINE OR PENTAAMINE OR PENTAMMINE       backspacing
      pstg 34
SS 9  16 AND 8
      no match
```

SEARCH #1

Novice L

```
      prompt (note 24)
SS 1  INDUCED ELECTRON TRANSFER REACTIONS AND OXIDIZABLE LIGANDS   prompt (note 25)
      no pstg (induced electron transfer reactions).
      no pstg (oxidizable ligands).
SS 1  INDUCED AND ELECTRON AND TRANSFER AND REACTIONS AND OXIDIZABLE LIGANDS
      no pstg (oxidizable ligands).
      no match
SS 1  ELECTRON TRANSFER AND ELECTRON EXCHANGE REACTIONS   prompt (note 26)
      no pstg (electron transfer).
      no pstg (electron exchange reactions).
SS 1  ELECTRON AND TRANSFER                               prompt (note 27)
ss 1  pstg 2916
SS 2  ELECTRON AND EXCHANGE                               prompt (note 28)
ss 2  pstg 3134
SS 3  ONE OR TWO$
SS 3  1 OR 2                                              prompt (note 29)
      pstg 5010
SS 4  LIGAND OR LIGANDS
      pstg 6918
SS 5  3 AND 4
      pstg 101
SS 6  OXIDIZ:
      mm 22
      ALL
ss 6  pstg 5147
SS 7  OXIDAT
      no pstg (oxidat).
SS 7  ALL OXIDAT:
      pstg 30355
SS 8  6 OR 7
      pstg 34576
SS 9  HIS
SS 9  5 AND 8
      pstg 3
SS 10 PRINT 3
SS 10 PRINT TRIAL 3
SS 10 35$
      no pstg (35$).
SS 10 5 AND COMPLEX:
      mm 77
      all or none
      ALL
      pstg 70
SS 11 PRINT TRIAL
SS 11 PRT OFFLINE
```

SEARCH #1

Novice M

```
SS 1  CHELATE AND LIGANDS
      pstg 134
SS 2  ELECTRON EXCHANGE AND 1
      no pstg (electron exchange).
      no match
SS 2  ELECTRON AND EXCHANGE AND 1                    prompt (note 30)
      pstg 2
SS 3  PRINT TRIAL                                    prompt (note 31)
SS 3  FERRICYANIDE AND PENTAAMINE COBALT111 ELECTRON AND TRANSFER
      no pstg (pentaamine cobaltlll electron).
      no match
SS 3  FERRICYANIDE AND PENTAAMINE COBALT 111 AND ELECTRON TRANSFER
      no pstg (pentaamine cobalt 111).
      no pstg (electron transfer)
      no match
SS 3  FERRICYANIDE                                ]  prompt (note 32)
      pstg 559                                    ]
SS 4  PENTAAMINE AND COBBALT                      ]
      no pstg (cobbalt).                          ]
      no match                                    ]
SS 4  PENTAAMINE AND COBALT                       ]
      pstg 4                                      ]
SS 5  ELECTRON AND TRANSFER                       ]
      pstg 2916                                   ]
SS 6  3 AND 5
      pstg 20
SS 7  HIS
SS 7  6 AND 4
      no match
SS 7  4 AND 5
      pstg 2
SS 8  7 AN$
SS 8  7 OR 6
      pstg 22
SS 9  PRINT TI 22                                    backspacing
SS 9  TAUBE,  H:/AU
      mm 5
      1 OR 4
      pstg 45
SS 10 HIS
      9 AND 5
      pstg 4
SS 11 8 OR 10
      pstg 26
SS 12 HIS
SS 12 PRT OFFLINE
```

SEARCH #2

Experienced Searcher A

```
                                                                    backspace
SS 1  CARBON AND MONOXIDE;  FD 7732-18-5/RN;  EQUILIBRIUM;  FD EQUILIBRIUM; FD MASS AND T
      ANSFER;  FD SALT AND WATER;  FD BRINE
ss 1  pstg 7256
ss 2  pstg 18780
ss 3  'equilibrium' is not a recognized command name.
SS 3  FD EQUILIBRIUM;  FD MASS AND TRANSFER;  FD SALT ANS WATER;  FD BRINE
ss 3  pstg 7230
ss 4  pstg 4073
ss 5  no pstg (salt ans water).
ss 5  pstg 1708
SS 6  SALT AND WATER;  FD BRINE
ss 6  pstg 2858
ss 7  pstg 1708
SS 8  HISTORY
SS 8  1 OR 2;FD 5 OR 6
ss 9  pstg 25656
ss 10 pstg 4490
SS 10 8 AND 9
      pstg 402
SS 11 10 AND 4 OR 10 AND 3
ss 11 pstg 4
SS 12 PRT TI                                          comment (note 33)
SS 12 1 AND (3 OR 4) AND 9
      no match
SS 12 1 AND 3 OR 1 AND 4
ss 12 pstg 96
SS 13 PRT OFFLINE SS 11  4
```

Experienced Searcher B

```
SS 1  FILE CHEMDEX                                    comment (note 34)
SS 1  CARBON AND MONOXIDE
      no pstg (monoxide).
      no match
SS 1  CO
      pstg 49
SS 2  CARBON MONOXIDE
      pstg 1
SS 3  PRINT FULL
SS 3  FILE CAS7276
      ERROR REENTER INPUT
      FILE CAS7276
SS 1 630-08-0/RN
      pstg 8260
SS 2  WATERS, OCEAN;AND BRINE                         backspace
      pstg 2589
SS 3  BRINE
      pstg 1708
SS 4  3 OR 2
      pstg 4265
SS 5  4 AND 1
      pstg 9
SS 6  PRT OFFLINE
```

SEARCH #2

Experienced Searcher C

```
SS 1  124-38-9/RN AND 630-08-0/RN                          backspace
      pstg 1518
SS 2  1 AND SALT OR SALINE$
SS 2  1 AND ALL SALT# OR ALL SALINE
      no match
SS 2  1 AND (ALL SALT# OR ALL SALIN:)                      backspace
      pstg 9
SS 3  PRT AN TI IT
SS 3  1 AND (EQUILIBRIUM OR FORMATION OR STABILITY) AND (CONSTANT OR ALL CONST#  comment
      unbalanced parentheses in search statement.  search aborted.              (note 35)
SS 3  1 AND EQUILIBRIUM OR FORMATION OR STABILITY) AND (ALL CONSTANT# OR ALL CONST#)
      pstg 2
SS 4  PRT AN TI IT
SS 4  124-38-9/RN
      pstg 11056
SS 5  630-08-0/RN
      pstg 8260
SS 6  EQUILIBRIUM OR FORMATION
      pstg 130453
SS 7  4 AND 6
      pstg 1637
SS 8  7 AND(SALT OR SALINE)
      pstg 19
SS 9  PRT AN TI IT
SS 9  630-08-0$
SS 9  5 AND (ALL OXIDAT:OR OXIDN)                          backspace
      pstg 943                                             comment (note 36)
SS 10 9 AND ALL SALT#
      pstg 7
SS 11 PRT AN TI IT
SS 11 124-38-9/RN AND (PREPN OR FORMATION) AND EQUILIBRIUM
      too many pstgs in this ss.  revise search strategy.
SS 11 124-38-9/RN AND EQUILIBRIUM                          backspace
      pstg 260
SS 12 11 AND (PREPN OR FORMATION)
SS 12 NBR 124-38-9/RN
SS 12 124-38-9, PREPN/RN
      pstg 489
SS 13 124-38-9, PROP/RN
      pstg 3064
SS 14 13 AND EQUILIBRIUM
      pstg 120
SS 15 14 AND SALT
      pstg 1
SS 16 PRT FU
SS 16 ERASEALL
```

SEARCH #2

Semi-Experienced Searcher E

```
SS 1  EQUILIBRIUM
      pstg 7230
SS 2  EQUILIBRIUM CONSTANT
      np (equilibrium constant)
SS 2  CARBON MOMOXIDE                          backspace
      np (carbon monoxide)
SS 2  CARBON AND MONOXIDE                      prompt (note 37)
      pstg 7256
SS 3  EQUILIBRIUM AND CONSTANT                 prompt (note 38)
      pstg 272
SS 4  CARBON AND DIOXIDE
      pstg 11143
SS 5  SAVEHOLD                                 backspace
      np (savehold)
SS 5  SAVEOLD
      saveold completed
SS 5  FILE CHEMDEX
SS 1  C101/MF
      np (C101/MF
SS 1  CARBON MONOXIDE
      pstg 1
SS 2  PRT
SS 2  CARBON DIOXIDE                           backspace
      pstg 1
SS 3  PRT
SS 3  FILE CAS7276
SS 1  RECALL
ss 1  equilibrium (7230)
ss 2  carbon and monoxide (7256)
ss 3  equilibrium and constant (272)
ss 4  carbon and dioxide
SS 5  630-08-0/RN
      pstg 8260
SS 6  124-38-9/RN
      pstg 11056
SS 7  OXIDATION
      pstg 25635
ss 8  WATERS,OCEAN
      np (waters,ocean)
SS 8  WATERS, OCEAN
      pstg 2589
SS 9  3 AND 5 AND 6
      none
SS 9  3 AND 5
      pstg 2
SS 10 9 AND 7
      none
```

SEARCH # 2

Semi-Experienced Searcher E - Continued

```
SS 10 HIS
SS 10 1 AND 5 AND 6 AND 7
      pstg 1
SS 11 5 AND 6 AND 8
      none
SS 11 5 OR 6 AND 8                                  prompt (note 39)
      pstg 8338
SS 12 3 OR 7
      pstg 25906
SS 13 5 OR 6
      pstg 17798
SS 14 8 AND 13
      pstg 87
SS 15 HIS
SS 15 7 AND 14
      none
SS 15 3 AND 14
      none
SS 15 1 OR 3
      pstg 7230
SS 16 PH
      pstg 7347
SS 17 IONIC STRENGTH
      np (ionic strength)
SS 17 PRESSURE
      pstg 22545
SS 18 IONS IN LIQUIDS
      pstg 1442
SS 19 TEMPERATURE
      pstg 31587
SS 20 14 AND 16                                     prompt (note 40)
      pstg 7
SS 21 14 AND 17
      pstg 4
SS 22 14 AND 18
      none
SS 22 14 AND 19
      pstg 2
SS 23 HIS
SS 23 9 OR 10 OR 20 OR 21 OR 22
      pstg 15
SS 24 PRT OFFLINE
```

SEARCH #2

Semi-Experienced Searcher F

```
SS 1  FILE CHEMDEX
SS 1  CO
      pstg 49
SS 2  CO/MF
      pstg 49
SS 3  CARBOPN$                                  prompt (note 41)
SS 3  CARBON MONOXIDE                           prompt (note 42)
      pstg 1
SS 4  PRINT
SS 4  CARBON DIOXIDE
      pstg 1
SS 5  PRINT
SS 5  FILE CAS7276
SS 5  630-08-0/RN AND 124-39-9

      no pstg (124-39-9)
      no match
SS 1  630-08-0/RN AND 124-39-9/RN
      no pstg (124-39-9/RN)
      no match
SS 1  630-08-0/RN AND 124-39-9/RN
      pstg 1518
SS 2  1 AND EQUILIBRIUM
      pstg 29                                   comment  prompt (note 43)
SS 3  PRINT 3
SS 3  2 AND ALGA:
      mm (alga:) (27)
      9 (ALGAE)
      no match
SS 3  2 2 AND $                                 prompt (note 44)
SS 3  2 AND SALT AND WATER
      no match                                  comment (note 45)
SS 3  2 AND IONIC AND STREGTH
      no match
SS 3  2 AND IONIC STRENGTH
      no pstg (ionic strength)
      no match
SS 3  2 AND PH
      no match
SS 3  PH
      pstg 7347
SS 4  3 AND 2
      no match
SS 4  2 AND PRESSURE
      no match
SS 4  2 AND TEMPERATURE
      pstg 2
```

SEARCH #2

Semi-Experiences Searcher F - Continued

```
SS 5  PRINT
SS 5  MASS AND TRANSFER AND OVWERTONES$
SS 5  MASS AND TRANSFER AND OVERTONES
      no match
```

Semi-Experienced Searcher G

```
SS 1  630-08-0/RN AND OXIDATION
      pstg 757
SS 2  WATER
      pstg 80685
SS 3  1 AND 2
      pstg 21
SS 4  PRINT
SS 4  L24-38-9 AND 630-08-0
      no pstg (L24-38-9).
      no pstg (630-08-0).
SS 4  124-38-9 AND 630-08-0
      no pstg (124-38-9).
      no pstg (630-08-0).
SS 4  HIS
SS 4  L24-38-9 AND PREPARATION
      no pstg (L24-38-9).
      no match
SS 4  124-38-9 AND PREPARATION                    prompt (note 46
      no pstg (124-38-9).
      no match
SS 4  124-38-9 AND FORMATION
      no pstg (124-38-9).
      no match
SS 4  CARBON DIOXIDE AND FORMATION
      no pstg (carbon dioxide).
      no match
SS 4  FILE CHEMDEX
SS 1  CARBON DIOXIDE
      pstg 1
SS 2  PRINT
SS 2  CA$
SS 2  FILE CAS7276
SS 1  124-38-9/RN AND PREPARATION
      pstg 62
SS 2  WATER                                       comment (note 47)
      pstg 80685
SS 3  1 AND 2
      pstg 5
SS 4  PRINT
SS 4  ERASEALL
```

SEARCH #2

Semi-Experienced Searcher H

```
SS 1  EQUILIBRIUM
      pstg 7230
SS 2  CONSTAB$
SS 2  CONSTANT
      pstg 18861
SS 3  CARBON MONOXIDE                          comment (note 48)
      no pstg (carbon monoxide).
SS 3  CARBONMONOXIDE
      pstg 11
SS 4  CO
      pstg 2157
SS 5  CARBON DIOXIDE
      no pstg (carbon dioxide).
SS 5  CO2                                      comment (note 49)
      pstg 169
SS 6  CARBON
      pstg 57080
SS 7  MONOXIDE
      pstg 8390
SS 8  DIOXIDE
      pstg 27438
SS 9  1 AND 2 AND 6 AND 7 AND 8
      pstg 1                                   comment (note 50)
SS 10 PRINT 1 SS 9
SS 10 SALT
      pstg 25507
SS 11 SALT AND WATER
      pstg 2858
SS 12 6 AND 7 AND 8 AND 11
      no match
SS 12 MARINE
      pstg 3449
SS 13 6 AND 7 AND 8 AND 12
      no match
SS 13 OCE$
SS 13 ALL OCEAN:
      pstg 4017
SS 14 6 AND 7 AND 8 AND 13
      pstg 4
SS 15 PRINT 4 SS 14
SS 15 PH
      pstg 7347
SS 16 15 AND 13
      pstg 43
SS 17 TEMPERATURE
      pstg 31587
SS 18 16 AND 17
      pstg 1
SS 19 PRINT 1 SS 18
SS 19 IONIC AND STRENGTH
      pstg 615
```

(Continued next page.)

SEARCH #2

Semi-Experienced Searcher H - Continued

```
SS 20 13 AND 19
      no match
SS 20 6 AND 7 AND 8 AND 15
      pstg 3
SS 21 PRINT 3 SS 20
SS 21 6 AND 7 AND 8 AND 17
      pstg 39
SS 22 20 AND 21
      no match
SS 22 ALL ALGA:
      pstg 3564
SS 23 6 AND 7 AND 8 AND 22
      pstg 1
SS 24 PRINT 1 SS 23
SS 24 BACTERIA
      pstg 10170
SS 25 6 AND 7 AND 8 AND 24
      no match
SS 25 1 AND 6 AND 7 AND 8
      pstg 20                                  comment (note 51)
SS 26 PRINT 20 SS 25
SS 26 ERASEALL
```

Novice J

```
SS 1  ALL REVIEW:                              prompt (note 52)
      pstg 138565
SS 2  CARBON MONOXIDE OR CO
      np (carbon monoxide)
      pstg 2157
SS 3  CARBON DIOXIDE OR CO2
      np (carbon dioxide)
      pstg 169
SS 4  EQUILIBRIUM CONSTANTS
      np (equilibrium constants)
SS 4  EQUILIBRIUM AND CONSTANTS
      none
SS 4  EQUILIBRIUM
      pstg 7230
SS 5  SALT WATER SALINE                        comment prompt (note 53)
      np (salt water saline)
SS 5  SALINE
      pstg 1050
SS 6  1 AND 2 AND 3 AND          AND 5   backspacine (illegible) prompt (note 54)
      none
SS 6  2 AND 3 AND 4 AND 5AND                  backspacing
      np (5and)
      none
SS 6  2 AND 3 AND 4 AND 5                     backspacing
      none
SS 6  ERASEALL
```

SEARCH #2

Novice K

```
SS 1  CARBON MONOXIDE                                  comment (note 55)
      no pstg (carbon monoxide).
SS 1  CARBON AND MONOXIDE                              prompt (note 56)
      pstg 7256
SS 2  OXIDATION
      pstg 25635
SS 2  1 AND 2
      pstg 696
SS 4  SALT WATER$
SS 4  SALT AND WATER
      pstg 2858
SS 5  3 AND 4                                          comment (note 57)
      no match
SS 5  IONIC STRENGTH
      no pstg (ionic strength).
SS 5  IONIC AND STRENGTH
      pstg 615
SS 6  3 AND 5
      no match
SS 6  SEA AND WATER
      pstg 3553
SS 7  3 AND 6
      no match
SS 7  CARBON AND DIOXIDE
      pstg 11143
SS 8  3 AND 7
      pstg 133
SS 9  BRINE                                            prompt (note 58)
      pstg 1708
SS 10 HIS                                              prompt (note 59)
SS 10 8 AND 9
      no match                                         comment (note 60)
SS 10 ERASEALL
```

Novice L

```
SS 1  EQUILIBRIUM CONSTANT                    comment  prompt (note 61)
      no pstg (equilibrium constant).
SS 1  EQUILIBRIUM AND ALL CONSTANT:   comment  prompt backspacing (note 62)
      pstg 568
SS 2  CARBON MONOXIDE
      no pstg (carbon monoxide).
SS 2  CARBON MONOXIDE $
SS 2  CARBON AND MONOXIDE OR CO
      pstg 9322
SS 3  ONE$
SS 3  1 OR 2
      no pstg (1 or 2).
```

SEARCH #2

Novice L - Continued

```
SS 3  1 AND 2
      pstg 5                                    comment (note 63)
SS 4  PRINT TRIAL 5
SS 4  HIS
SS 4  1 AND 2 AND PROTON TRANSFER$
SS 4  1 AND 2 AND PROTON AND TRANSFER
      pstg 1                                    prompt (comment) (note 64)
SS 5  FILE CHEMDEX          ]                   prompt (note 65)
SS 1  CARBON MONOXIDE       ]
      pstg 1                ]
SS 2  PRINT                 ]
SS 2  FILE CAS7276          ]
SS 1  630-08-0/RN           ]
      pstg 8260             ]
SS 2  1 AND ALL EQUIL:      ]
      pstg 122              ]
SS 3  SEA AND WATER OR SALT AND WATER           backspacing
      pstg 6244
SS 4  2 AND 3                                   comment (note 66)
      no match
SS 4  2 AND MASS AND TRANSFER                   backspacing
      pstg 1
SS 5  PRINT
SS 5  ERASEALL
```

Novice M

```
SS 1  7732-18-5/RN                              explanation (note 67)
      pstg 18780
SS 2  EQUILIBRIUM CONSTANTS
      no pstg (equilibrium constants).
SS 2  EQUILIBRIUM CONSYANT
      no pstg (equilibrium consyant).
SS 2  EQUILIBRIUM CONSTANT
      no pstg (equilibrium constant).
SS 2  EQUILIBRIUM AND CONSTANT
      pstg 272
SS 3  1 ANS
      no pstg (1 ans).
SS 3  1 AND 2
      pstg 4
SS 4  EQUILIBRIUM
      pstg 7230
SS 5  CARBON MONOXIDE
      no pstg (carbon monoxide).
SS 5  CARBON AND MONOXIDE
      pstg 7256
SS 6  HIS
SS 6  4 AND 5
      pstg 67
```

SEARCH #2

Novice M - Continued

```
SS 7 1 AND 6
     pstg 3
SS 8  CARBON AND DIOXIDE
     pstg 11143
SS 9  5 AND 8
     pstg 1119
SS 10 HIS
SS 10 1 AND 5 AND 8
     pstg 65
SS 11 4 AND 10
     pstg 1
SS 12 PRT AN TI
SS 12 HIS
SS 12 ERASALL$
SS 12 ERASEALL
```

SEARCH #3

Experienced Searcher A

```
SS 1  ALL NECHERS :/AU;$
SS 1  ALL NECHERS, D:/AU; FD ALL WROEBEL, H:/AU
ss 1  no pstg  (nechers, d:/au).
ss 1  no pstg  (wroebel, h:/au).
SS 1  NBR NECHERS/AU
      NBR WROEBEL/AU
      NBR LENZHOFF/AU
      NBR PATCHORNIK/AU
SS 1  PATCHORNIK:/AU
      mm (patchornik:) (4)
      ALL; PRT TI
ss 1  pstg 54
SS 2  PRT TI TRIAL SKIP 3                          comment (note 68)
SS 2  PRT TRIAL SKIP 3
SS 2  (POLYMER OR POLYMERS; FD REAGENTS; FD COENZYMES OR THIAMINE OR THIOZOLE OR
      no pstg ()polymer).
      pstg 3951
      continue entering ss 3
      PYRIDOXAL
      no pstg (thiozole).
ss 3  pstg 2244
SS 4  3 OR THIAZOLE
      pstg 3078
SS 5  4 AND POLYMER OR 4 AND POLYMERS
      pstg 24                                      comment (note 69)
SS 6  2 AND POLYMER OR 2 AND POLYMERS
      pstg 124
SS 7  6 OR 2 AND POLYMERIC
      pstg 127
SS 8  4 AND POLYMERIC OR 5
      pstg 24
SS 9  7 OR 8
      pstg 151
SS 10 PRT TI SS 7; PRT TI SS 8
SS 10 7 AND BIOCHEMICAL
      no match.
SS 10 BIOCHEMICAL AND (POLYMER ORRPOLYY$           backspacing
SS 10  BIOCHEMICAL AND (POLYMER OR POLYMERS OR POLYMERIC)
      pstg 18
SS 11 PRT TI
SS 11 8 OR 10
      pstg 42
SS 12 PRT OFFLINE
```

SEARCH #3

Experienced Searcher B

```
SS 1  POLYMERS; FD STYRENE; FD DIVINYL AND BENZENE
ss 1  pstg 58930
ss 2  pstg 15837
ss 3  pstg 52
SS 4  2 AND 3
      pstg 28
SS 5  4 OR 1
      pstg 58944
SS 6  COENZYMES OR SUBSTRATES OR REAGENTS
      pstg 8407
SS 7  6 AND 5
      pstg 490
SS 8  SYNTHESIS OR REACTIONS
SS 8  BACKUP
SS 7  6 AND 5
      pstg 490
SS 8  SYNTHESIS
      pstg 52427
SS 9  REACTIONS
      pstg 165651
SS 10 9 OR 8
SS 10 BACKUP
SS 9  REACTIONS
      pstg 165651
SS 10 7 AND 8
      pstg 28
SS 11 7 AND 9
      pstg 43
SS 12 11 OR 10
      pstg 60
SS 13 PRINT AU,TI SKIP 57                    prompt (note 70)
SS 13 PRINT FULL SKIP 57
SS 13 PRINT FULL SS 12 2
SS 13 HIS
SS 13 PRT OFFLINE
```

Experienced Searcher C

```
SS 1  NECHERS, D:/AU
      no pstg (nechers, d:/au).
SS 1  NECHERS,D:/AU                          backspacing
      no pstg (nechers,d:/au).
SS 1  NBR NECHERS/AU
      LENZHOFF, A:/AU
      no pstg (lenzhoff, a:/au).
```

SEARCH #3

Experienced Searcher C - Continued

```
SS 1  PATCH$
SS 1  NBR PATCH/AU
      NBR PATCHUNIK/AU
      PATCHORNIK, A:/AU
      mm (patchornik, a:) (4)
      ALL
      pstg 54
SS 2  1 AND POLYMER## AND (SUBSTRATE# OR ALL REAGENT#)
      mm (polymer##) (18)
      ALL
      mm (substrate# (4)
      ALL
      pstg 11
SS 3  PRT  AN TI IT
      pstg 974
SS 4  BENZENE AND ETHENYL
      pstg 3123
SS 5  3 AND 4
      pstg 68
SS 6  PRT AN TI IT
      PRT CC
SS 6  5 AND SEC34/CC
      pstg 10
SS 7  2 AND NOT 6
      pstg 9
SS 8  PRT AN TI CC
SS 8  PRT IT 4 SKIP 1
      3 AND (ALL PEPTIDE: OR ORGANIC)
      pstg 79
SS 9  PRT TI IT
SS 9  PRT OFFLINE
```

SEARCH #3

Semi-Experienced Searcher E

```
SS 1  POLYMER:
      mm (polymer:  (86)
      ALL
      pstg 101952
SS 2  BOUND
      pstg 4614
SS 3  SUPPORT:
      mm (support:) (9)
      SUPPORT:
      np (support:)
SS 3  SUPPORT:
      mm (support:) (9)
      1 or 2
      1 OR 2 OR 7 OR 8
      pstg 4844
SS 4  REAGENT:
      mm (reagent:) (10)
      1 OR 8
      pstg 8232
SS 5  IMMOBILIZED
      pstg 1469
SS 6  HIS
SS 6  2 OR 3 OR 4 OR 5
      pstg 18863
SS 7  1 AND 6
      pstg 1390
SS 8  POLYSTYRENE
      pstg 7351
SS 9  6 AND 8
      pstg 149
SS 10 COENZYME
      pstg 1529
SS 11 9 AND 10
      none
SS 11 7 AND 10
      pstg 3
SS 12 PRT FULL 3
      PRT TRIAL 3
SS 12 HIS
SS 12 THIAZOLE:
      mm (thiazole:) (79)
      all or none
      ALL
      pstg 1068
SS 13 7 AND 12
      none
```

SEARCH #3

Semi-Experienced Searcher E - Continued

```
SS 13 6 AND 12
      pstg 15
SS 14 THIAMINE:
      mm (thiamine:) (10)
      1 OR 2 OR 5 OR 7 OR 8
      pstg 1339
SS 15 7 AND 14
      none
SS 15 9 AND 14
      none
SS 15 1 AND 14
      pstg 1
SS 16 PRT TRIAL
SS 16 1 AND 12
      pstg 21
SS 17 8 AND 12
      none
SS 17 PYRIDOXAL:
      mm (pyridoxal:) (11)
      ALL
      pstg 630
SS 18 7 AND 17
      none
SS 18 1 AND 17
      pstg 6
SS 19 HIS
SS 19 1 AND 2
      pstg 388
SS 20 10 AND 19
      pstg 1
SS 21 PRT TRIAL
SS 21 MODEL
      pstg 32223
SS 22 7 AND 22
      pstg 263
SS 23 2 AND 23
      pstg 12
SS 24 HIS
SS 24 9 OR 11 OR 13 OR 15 OR 16 OR 18 OR 20 OR 23
      pstg 206
SS 25 PRT OFFLINE
```

Semi-Experienced Searcher F

```
SS 1  POLYMER-BOUND
      no pstg (polymer-bound).                    prompt (note 71)
SS 1  POLYMER AND BOUND
      pstg 279
SS 2  BIOLOGICAL OR BIOCHEMICAL
      pstg 58324
```

SEARCH #3

Semi-Experienced Searcher F - Continued

```
SS 3  1 AND 2
      pstg 5                                        comment (note 72)
SS 4  3 AND REAGENT#
      mm (reagent#) (3)
      1,2
      no match
SS 4  PRINT SS3 5                    'SS3' is not a valid pring parameter.
SS 4  PRINT SS 3 5                   command ignored.
SS 4  2 AND REAGENT#
      mm (reagent#) (3)
      1,2
      pstg 180
SS 5  THIAMINE OR THIAZOLE                          comment (note 73)
      pstg 2173
SS 6  5 AND 4
      pstg 1
SS 7  PRINT
SS 7  "__NECHERE$
SS 7  NECHERS, D/AU AND4
      search syntax error.  search aborted
SS 7  NECHERS, D/AU :/AU AND 4                      prompt (note 74)
      search syntax error.  search aborted
SS 7  NECHERS, D:/AU AND 4
      no pstg (nechers, d:/au).
      no match
SS 7  LEUIZHOFF,A:/AU AND 4                         line garbage
      no pstg (leuzhoff,a:/au).
      no match
SS 7  LENIZ OFF A:/AU AND 4                         line garbage  comment (note 75)
      no pstg (lenzoff,a:/au).
      no match
SS 7  LENZHOFF,A:/AU AND 4
      no pstg (lenzhoff,a:/au).
      no match
SS 7  PATCHORNIK,A:/AU AND 4
      no pstg (patchornik,a:/au).
      no match
SS 7  WROEBEL,H:/AU AND 4
      no pstg (wroebel,h:/au).
      no match
SS 7  PRT SS 3 5 OFFLINE
```

SEARCH #3

Semi-Experienced Searcher G

```
SS 1  POLYMER AND REAGENT:
      no pstg ("polymer).                          line garbage
      mm (reagent:) (10)
      ALL
      no match
SS 1  POLYMERIZATION
      pstg 25514
SS 2  ALL REAGENT
      pstg 8232
SS 3  1 AND 22
      no match
SS 3  1 AND 2
      pstg 36
SS 4  STYRENE
      no pstg ()styrene).                          line garbage
SS 4  100-42-5/RN
      pstg 3495
SS 4  4 AND 3
      pstg 1
SS 6  PRINT
SS 6  POLYSTYRENE
      pstg 7351
SS 7  ADDITION REACTION
      pstg 2837
SS 8  6 AND 7
      pstg 3
SS 9  PRINT
SS 9  BENZENE, ETHENYI
      no pstg (benzene, ethenyl).
SS 9  100-42-5/RN
      no pstg ()100-42-5/RN).
SS 9  HIST
SS 9  DIVINYLBENZENE
      pstg 1094
SS 10 DERIVATIVES
      pstg 41208
SS 11 16 AND 4
      pstg 148
SS 12 THIAMINE PYROPHOSPHATE
      no pstg (thiamine pyrophosphate).
SS 12 THIAMINE AND PYROPHOSPHATE
      pstg 79
SS 13 12 OR TPP
      pstg 91
```

SEARCH #3

Semi-Experienced Searcher G - Continued

```
SS 14 11 AND 14
      error reenter input
      11 AND 13
      no match
SS 14 THIAMINE
      pstg 1339
SS 15 PYRIDOXAL                                  comment (note 76)
      pstg 626
SS 16 14 AND 15
      pstg 5
SS 17 11 AND 14
      no match
SS 17 11 OR 14
      no pstg (11 or 14).
SS 17 11 OR 14
      pstg 1487
SS 18 11 AND 14
      no match
SS 18 PYRIDOXAL PHOSPHATE
      no pstg ()pyridoxal phosphate).            line garbage
SS 18 11 AND REACTION
      pstg 58
SS 19 PRINT TRIAL
SS 19 PRINT TITLE
SS 19 DECARBOXYLATION
      pstg 1912
SS 20 HIS
      CARBOXYLATION
      pstg 722
SS 21 HIS
SS 21 11 AND 19
      no match
SS 21 TRANSAMINATION
      pstg 212
SS 22 11 AND 21
      no match
SS 22 9 AND REACTION
      no pstg ("9).
      no match
SS 22 6 AND 13
      no match
SS 22 11 AND 13
      no match
SS 22 ERASEALL
```

SEARCH #3

Semi-Experienced Searcher G - Continued

```
SS 21 15 AND 20
      pstg 1
SS 22 PRINT 1 SS 21
SS 22 LENZHOFF,:/AU
      no pstg (lenzhoff,:/au).
SS 22 PATCHORNIK,:/AU
      mm (patchornik,:) (4)
      ALL
      pstg 54
SS 23 14 AND 22
      pstg 4
SS 24 PRINT 4 SS 23
SS 24 WROEBEL:/AU
      no pstg (wroebel:/au).
SS 24 15 AND NOT ALL PROTEIN:
      pstg 40
SS 24 15 $
SS 25 AMINO AND ACID
      pstg 23506
SS 26 15 AND NOT 25
      pstg 32
SS 27 PEPTIDE
      pstg 8458
SS 28 15 AND NOT 27
      pstg 17
SS 29 PRIM$
SS 29 PRINT 17 SS 28
SS 29 13 OR 23 OR 28

SS 30 PRT OFFLINE
```

Novice J

```
SS 2  1ALL REVIEWS:
      np (1all reviews:)
SS 2  POLYMER SYNTHESIS
      np (polymer synthesis)
SS 2  POLYMER AND SYNTHESIS
      pstg 1360
SS 3  POLYMER AND REACTIONS
      pstg 3304
SS 4  1 AND 6 AND 7
      pstg 8
SS 5  PRINT TRIAL
SS 5  PRT OFFLINE
```

SEARCH #3

Semi Experienced Searcher H

```
SS 1  ALL :POLYSTYRENE
      search term may not begin with ':' character.  term deleted.
      no pstg (:polystyrene).
SS 1  POLYSTYRENE
      pstg 7351
SS 2  SYNTHESIS
      pstg 52427
SS 3  SOLID AND STATE
      pstg 4801
SS 4  1 AND 2 AND 3
      no match
SS 4  CHLOROMR$
SS 4  CHLOROMETHYLPOLYSTYRENE
      pstg 2
SS 5  PRINT 2 SS 4
SS 5  2 AND 3
      pstg 57
SS 6  5 AND NOT PROTEIN
      pstg 56
SS 7  5 AND NOT PROTEINS                          comment (note 77)
      pstg 56
SS 8 POLYMER AND BOUND
      pstg 279
SS 9  THIAMINE
      pstg 1339
SS 10 8 AND 9
      no match
SS 10 ALL PYRIDOX:
      pstg 1158
SS 11 8 AND 10
      no match
SS 11 BIOCHEMICAL
      pstg 7246
SS 12 8 AND 11
      no match
SS 12 3 AND 11
      no match
SS 12 1 AND 11
      no match
SS 12 1 AND 9
      pstg 1
SS 13 PRINT 1 SS 12
SS 13 1 AND 10
      no match                                    comment (note 78)
SS 13 NECKERS,D.C./AU
      no pstg (neckers,d.c./au).
```

SEARCH #3

Semi-Experienced Searcher H - Continued

```
SS 13 NECKERS/AU
      no pstg (neckers/au).
SS 13 LENZHOFF/AU
      no pstg (lenzhoff/au).
ss 13 PATCHORNIK/AU
      no pstg (patchornik/au).
SS 13 WROEBEL/AU
      no pstg (wroebel/au).
SS 13 WOODWARD/AU
      no pstg (woodward/au).
SS 13 NECKERS:/AU
      mm (neckers:) (6)
      1 AND 2
      pstg 11
SS 14 1 OR $
SS 14 PRINT 11 SS 13
SS 14 SOLID AND PHASE
      pstg 3826
SS 15 14 AND 9
      no match
SS 15 14 AND 10
      no match
SS 15 4 AND 14
      no match
SS 15 1 AND 14
      pstg 41
SS 16 ALDOL
      pstg 297
SS 17 15 AND 16
      no match
SS 17 DECARBOXYLATION
      pstg 1912
SS 18 15 AND 17
      no match
SS 18 TRANSAMINATION
      pstg 212
SS 19 15 AND 18
      no match
SS 19 15 AND 11
      no match
SS 19 ALL COENZYME:
      pstg 1625
SS 20 15 AND 19
      no match
SS 20 ALL REACTION:
SS 20 REAGENT
      pstg 8232
```

SEARCH #3

Novice K

```
SS 1  POLYMERS
      pstg 58930
SS 2  REAGENTS
      pstg 3951
SS 3  1 AND 2
      pstg 96
SS 4  COENZYME                                    comment (note 79)
      pstg 1529
SS 5  3 AND 4
      no match
SS 5  ALDOL AND CONDENSATION
      pstg 254
SS 6  3 AND 5
      no match
SS 6  DECARBOXILATIONS
      no pstg (decarboxilations).
SS 6  TRANSAMINATION
      pstg 212
SS 7  3 AND 7
      pstg 1
SS 8  3 AND 6
      no match
SS 8  THIAMINE
      pstg 1339
SS 9  3 AND 8
      no match                                    comment  prompt (note 80)
SS 9  NECHERS, D:/AU
      no pstg (nechers, d:/au).
SS 9  LENZHOFF, A:/AU
      no pstg (lenzhoff,a:/au).
SS 9  PATCHORNIK,A:/AU
      mm (patchornik, a:) (4)
      ALL
      pstg 54
SS 10 HIS
SS 10 1 AND 9                                     prompt (note 81)
      pstg 20                                     prompt (note 82)
SS 11 PRT TRL
SS 11 PRT TRIAL
SS 11 PRT TRIAL SKIP 2 3
SS 11 BIOCHEM:
      mm (biochem:) (31)
      all or none?
      ALL
      pstg 12329
SS 12 11 AND ALL POLYMER: AND ALL REAGENT:
      pstg 1
```

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SEARCH #3

Novice K - Continued

```
SS 13 PRINT
SS 13 11 AND ALL POLYMER:
      pstg 79
SS 14 PRINT TI 6
SS 14 PRT OFFLINE
```

Novice L

```
SS 1  POLYMERABOUBOUN$$                          backspacing
SS 1  POLYMER AND BOUND AND REAGENTS
      pstg 8
SS 2  1 AND COENZYMES AND BIOCHEMICALS           comment (note 83)
      no match
SS 2  1 AND THIAMINE AND THIZOLE
      no match
SS 2  THIAMINE AND THIAZOLE                      prompt (note 84)
      pstg 24
SS 3  2 AND ALL POLYMER:
      no match
SS 3  THIAMINE OR THIAZOLE
      pstg 2173
SS 4  3 AND ALL POLYMER
      pstg 12
SS 5  PRINT TRIAL
SS 5  HIS
SS 5  1 AND ALL ENZYMES:                         prompt (note 85)
      no match
SS 5  PRT OFFLINE   SS  4
```

SEARCH #3

Novice M

SS 1 100-42-5/RN
pstg 3495
SS 2 2039-93-2/RN
pstg 29
SS 3 HIS
SS 3 1 AND 2
pstg 10
SS 4 BENZENE
pstg 15999
SS 5 DIVINYL
pstg 325
SS 6 4 AND 4
pstg 52
SS 7 HIS
SS 7 3 AND 6
no match
SS 7 1 AND 6
pstg 1
SS 8 2 AND 6
no match
SS 8 BIOCHEMICAL
pstg 7246
SS 9 REAGENTS
pstg 3951
SS 10 8 AND 9
pstg 7
SS 11 HIS
SS 11 6 AND 10
no match
SS 11 POLYMER
pstg 52853
SS 12 BOUND
pstg 4614
SS 13 11 AND 12
pstg 279
SS 14 8 AND 13
no match
SS 14 9 AND 13
pstg 8
SS 15 HIS
SS 15 6 AND 13
pstg 2
SS 16 PATCHORNIK, A/AU
no pstg (patchornik, a/au).

(Continued next page)

SEARCH #3

Novice M - Continued

```
SS 16 LENZHOFF, :/AU                                              prompt (note 86)
      no pstg (lenzhoff, :/au).
SS 16 PATCHORNIK, A:/AU                                           prompt (note 87)
      mm (patchornik, a:) (4)
      all or none
      ALL
      pstg 54
SS 17 HIS
SS 17 13 AND 16
      pstg 8
SS 18 ALL POYMER: AND ALL REAGENT:
      no match
SS 18 ALL POLYMER: AND ALL REAGENT:; FD 12 AND 18; FD 16 AND 18 ] prompt (note 88)
ss 18 pstg 259                                                    ]
ss 19 pstg 11                                                     ]
ss 20 pstg 11                                                     ]
SS 21 ALL POLYMER: AND 16                                         ]
      pstg 23                                                     ]
SS 22 HIS                                                         ]
SS 22 16 AND 18                                                   ]
      pstg 11                                                   comment (note 89)
SS 23 6 AND 13
      pstg 2
SS 24 22 OR 23
      pstg 13
SS 25 HIS
SS 25 6 OR 13 OR 17

SS 26 PRT OFFLINE
```

SEARCH #4

Experienced Searcher A

```
SS 1  HYDROGEN AND BONDING AND ALL ALCOHOL#          comment (note 90)
      pstg 167
SS 2  PRT TI
SS 2  PRT OFFLINE
```

Experienced Searcher B

```
SS 1  ALL ALCOHOL:; FD HYDROGEN AND ALL BOND;        comment (note 91)
      pstg 16844
      time ovflw: cont? (y/n)
      N
SS 2  HYDROGEN AND ALL BOND:
      pstg 5575
SS 3  1 AND 2
      pstg 284                                       comment (note 92)
SS 4  EQUILIBRIUM AND ALL CONSTANT:; FD BOND AND STRENGTH
ss 4  pstg 568
ss 5  pstg 518
SS 6  4 OR 5
      pstg 1086
SS 7  6 AND3
      no pstg (6 and3).
SS 7  6 AND 3
      pstg 14                                        comment (note 93)
SS 8  PRINT TRIAL
SS 8  HIS
SS 8  PRT OFFLINE
```

Experienced Searcher C

```
SS 1  HYDROGEN BOND OR HEAT OF HYDROGEN BONDING
      pstg 4147
SS 2  1 AND (ALL ALCOHOL# OR ALL ALC#)
      pstg 331
SS 3  PRT TI IT
SS 3  PRT TI IT CC 5 SKIP 5
SS 3  2 AND NOT AMINE
      pstg 303
SS 4  3 AND NOT 2
      no match
SS 4  2 AND NOT 3
      pstg 28
SS 5  PRT TI
SS 5  PRT TI CC SS 2 SKI                           backspacing
SS 5  PRT TI CC SS 3 SKIP 5
SS 5  PRT OFFLINE SS 3
```

SEARCH #4

Semi-Experienced Searcher E

```
SS 1  ALCOHOL
      pstg 7469
SS 2  HYDROGEN BOND
      pstg 4041
SS 3  EQUILIBRIUM
      pstg 7230
SS 4  EQUILIBRIUM
      pstg 7230
SS 5  EQUILIBRIUM AND CONSTANT
      pstg 272
SS 6  1 AND 2 AND 6
      none
SS 6  1 A ND 2 AND 5
      none
SS 6  1 AND 2 AND 3
      none
SS 6  NMR
      pstg 19680
SS 7  1 AND 2 AND 6
      pstg 9
SS 8  POLYMER: OR OLIGIOMER
      mm (polymer:) (86)
      all or none
      ALL
      np (oligiomer)
      time ovflw: cont? (y/n)
SS 9  POLYMER: AND OLIGOMER
      pstg 101952
SS 9  HIS
SS 9  7 AND 8
      none
SS 9  INFRARED SPECTROSCOPY
      np (infrared spectroscopy)
SS 9  IR
      pstg 21114
SS 10 2 AND 3 AND 10
      pstg 20
SS 11 DIPOLE MOMENT
      pstg 2625
SS 12 2 AND 3 AND 12
      pstg 3
SS 13 ENTHALPY SOLUTION
      np (enthalpy solution)
SS 13 ENTHALPY
      pstg 4114
```

(Continued next page)

SEARCH #4

Semi-Experienced Searcher E - Continued

```
SS 14 2 AND 3 AND 14
      pstg 4
SS 15 HIS
SS 15 7 OR 10 OR 11 OR 14
      pstg 34
SS 16 PRINT TRIAL
SS 16 15 AND EQUILIBRIUM
      none
SS 16 PRT OFFLINE   SS 14
```

Semi-Experienced Searcher F

```
SS 1  HYDROGEN AND BONDING
      pstg 2663
SS 2  ALCOHOL#
      mm (alcohol#) (2)
      all or none
      ALL
      pstg 15313
SS 3  1 AND 2
      pstg 167
SS 4  POLYMER AND 3                                  comment (note 94)
      pstg 1
      ?ZRINT
      zrint is not a recognized explainable item
SS 5  PRINT
SS 5  MUCLEAR AND MAGNETIC AND RESONANCE AND3        comment (note 95)
      no pstg (resonance and3).
      no match
SS 5  NUCLEAR AND MAGNETIC AND RESONANCE AND 3
      pstg 13
SS 6  3 AND INFRARED AND ALL SPECTR
      pstg 31
SS 7  5 AND PROTON
      pstg 1                                         comment (note 96)
SS 8  PRINT
SS 8  5 AND CARBON-13
      no match
SS 8  (HEAT OR ENTHALPY) AND 3
      pstg 47
SS 9  5 OR 6 OR 8
      pstg 74                                        comment (note 97)
SS 10 PRT OFFLINE
```

SEARCH #4

Semi-Experienced Searcher G

```
SS 1  HYDROGEN BONDING                          backspacing
      pstg 1
SS 2  HYDROGEN BONDING                          comment (note 99)
      pstg 1
SS 3  HYDROGEN BOND
      pstg 4041
SS 4  ALCOHOL:
      mm (alcohol:) (31)
      all or none
      ALL
      pstg 16844
SS 5  3 AND 4
      pstg 240
SS 6  TERTIARY
      pstg 2614
SS 7  5 AND 6
      pstg 8
SS 8  PRINT 8                                   comment (note 100)
SS 8  597-49-9/RN
      pstg 26
SS 9  1 AND 8$
SS 9  3 AND 8
      pstg 2
SS 10 PRINT TRIAL                               comment (note 101)
SS 10 CARBOTETRACHLORIDE
      no pstg (carbotetrachloride).
SS 10 HIST
SS 10 9 AND 10
      no match
SS 10 597-93-3
      no pstg (597-93-3).
SS 10 597-49-3/RN
      no pstg (597-49-3/rn).
SS 10 597-93-3/RN
      no pstg ()5917-93-3/rn).
SS 10 597-93-3/RN
      pstg 10
SS 11 HIST
SS 11 5 AND 10
      no match
SS 11 MONODYDRIC AND ALIPHATIC
      no pstg (monodydric).
      no match
SS 11 ALIPHATIC
      pstg 3857
SS 12 11 AND 6 AND 4
      pstg 23
SS 13 13 AND 3
      pstg 34
SS 14 PRINT TRIAL
```

(Continued next page)

SEARCH #4

Semi-Experienced Searcher G - Continued

```
      PRINT TI
SS 14 9 OR 13
      pstg 36
SS 15 PRT OFFLINE
```

Semi-Experienced Searcher H

```
SS 1  HYDROGEN
      pstg 43767
SS 2  BONDINC
      pstg 8134
SS 3  ALL BON:
      pstg 28274
SS 4  ALL BOND:
      pstg 21826
SS 5  1 AND 4
      pstg 5575
SS 6  ALCOHOL
      pstg 7469
SS 7  5 AND 6
      pstg 101
SS 8  BOND
      pstg 14979
SS 9  STRENGTH
      pstg 19883
SS 10 7 AND 8 AND 9
      pstg 4
SS 11 PRINT 4 SS 10
SS 11 EQUILIBRIUM
      pstg 7230
SS 12 ALL CONSTANT:
      pstg 23576
SS 13 5 AND 6 AND 11 AND A$$
SS 13 5 AND 6 AND 11 AND 12
      no match
SS 13 5 AND 6 AND 11
      pstg 2
SS 14 PRINT 2 SS 13
SS 14 HINDERED
      pstg 729
SS 15 5 AND 6 AND 14
      no match
SS 15 STERIC
      pstg 1800
SS 16 5 AND 6 AND 15
      pstg 2
SS 17 PRINT
ss 17 DIMER
      pstg 2325
```

(Continued next page)

SEARCH #4

Semi-Experienced Searcher H - Continued

```
SS 18 D$ALL DIMER:
      no pstg (d$all dimer:).
SS 18 ALL DIMER:
      pstg 5868
SS 19 5 AND 6 AND 18
      pstg 3
SS 20 PRINT 3 SS 19
SS 20 BECKER,E.D./AU
      no pstg (becker,e.d./au).
SS 20 BECKER, E. D./AU
      pstg 1
SS 21 PRINT 1 SS 20
SS 21 RAO, C. N. R./AU
      pstg 98
SS 22 5 AND 21
      pstg 6
SS 23 PRINT 6 SS 22
SS 23 BERNAL, J. D./AU
      no pstg (bernal, j. d./au).
SS 23 LIPPINCOTT, E. R. /AU
      pstg 12
SS 24 5 AND 23
      pstg 1
SS 25 PRINT 1 SS 24
SS 25 POPLE, J. A./AU
      pstg 37
SS 26 5 AND 25
      pstg 4
SS 27 PRINT 4 SS 26
SS 27 HANNA, M./AU
      pstg 1
SS 28 PRINT 1 SS 27
SS 28 MCCLELLAN, A. L./AU
      pstg 2
SS 29 PRINT 2 SS 28
SS 29 MUT$
SS 29 MURTHY, A. S. N./AU
      pstg 8
SS 30 5 AND 29
      pstg 6
      too many ss. use keep or backup to continue searching.
     (10 OR 13 OR 19 OR 22 OR 24 OR 26 OR 28) explanation (note 102)

      ERASEALL
```

(Continued next page)

SEARCH #4

Semi-Experienced Searcher H - Continued

```
SS 1  HYDROGEN
      pstg 43767
SS 2  ALL BOND:
      pstg 21826
SS 3  ALCOHOL
      pstg 7469
SS 4  ALL ALCOHOL:
      pstg 16844
SS 5  1 AND 2 AND 4
      pstg 284
SS 5  1 AND #$
SS 6  ENERGY
      pstg 85241
SS 7  1 AND 2 AND 6
      pstg 827
SS 8  1 AND 2 AND 4 AND 6
      pstg 37
SS 9  BOND
      pstg 14979
SS 10 8 AND 9
      pstg 35                                   comment (note 103)
SS 11 MURTHY, A. S. N./AU
      pstg 8
SS 12 1 AND 2 AND 11
      pstg 6
SS 13 PRINT 6 SS 12
SS 13 PRT OFFLINE SS 10
```

Novice J

```
SS 1  HYDROGEN BONDING                          comment (note 104)
      pstg 1
SS 2  HYDROGEN BOND
      pstg 4041
SS 3  ALCOHOLS
      pstg 8601
SS 4  EXPERIMENTAL PROCEDURES PERTAINING TO HYDROGEN BOND
      no pstg (experimental procedures pertaining to hydrogen bond).
SS 4  1 AND 2
      no match
SS 4  2 AND 3
      pstg 185                                  comment (note 105)
SS 5  TECHNIQUES OR PROCEDURES
      pstg 5725
SS 6  4 AND 5
      no match
SS 6  2 AND 3 AND 5
      no match
SS 6  PRINT TRIAL                               comment (note 106)
SS 6  PRT OFFLINE
```

SEARCH #4

Novice K

```
SS 1  HYDROGEN BOND
      pstg 4041
SS 2  ENERGY
      pstg 85241
SS 3  ALCOHOL                                        prompt (note 107)
      pstg 7469
SS 4  ALCOHOLS OR 3
      pstg 15313
SS 5  1 AND 2 AND 4
      pstg 28
SS 6  EQUILIBRIUM                                    comment  prompt (note 108)
      pstg 7230
SS 7  6 AND CONSTANT
      pstg 272
SS 8  5 AND 7
      pstg 1                                         prompt (note 109)
SS 9  PRINT TRIAL
SS 9  HIS                                            prompt  comment (note 110)
SS 9  PRINT TI SS 5 5
      PRI$
SS 9  HIS
SS 9  PRT OFFLINE
```

Novice L

```
SS 1  HYDROGEN AND BONDING AND ALCOHOLS              prompt (note 111)
      pstg 136
SS 2  1 AND INTER ACTIONS
      no pstg (inter actions).
      no match
SS 2  1 AND INTERACTION                              backspacing
      pstg 7
SS 3  PRINT TRIAL
SS 3  1 AND 2 AND SPECIES FORMED                     prompt (note 112)
      no pstg (species formed).
      no match
SS 3  1 AND 2 AND SPECIES AND FORMED                 ]  prompt (note 113)
      no match                                       ]
SS 3  NMR OR NUCLEAR MAGNETIC RESONANCE AND ALL ALCOHOL:  ]
      pstg 19697                                     ]
SS 4  HYDROGEN BOND AND 3                            ]
      pstg 478                                       ]
SS 5  NMR OR$                                        ]
SS 5  (NMR OR NUCLEAR MAGNETIC RESONANCE) AND ALL ALCOHOL: ]
      pstg 296                                       ]
SS 6  5B$                                            ]
SS 6  5 AND HYDROGEN BOND                            ]
      pstg 28                                        ]
SS 7  PRINT TI 5
SS 7  PRT OFFLINE
```

SEARCH #4

Novice M

```
SS 1   BECKER, E:/AU
       specify numbers, all, or none                    prompt (note 114)
       2 15
       pstg 21
SS 2   ALCOHOL
       pstg 7469
SS 3   1 AND 2
       pstg 2
SS 4   HYDROGEN
       pstg 43767
SS 5   BONDING
       pstg 8134
SS 6   HIS
SS 6   2 AND 3 ANND
       no pstg (3 annd).
       no match
SS 6   2 AND 3 AND 4
       pstg 2
SS 7   2 AND 4 AND 5
       pstg 53
SS 8   1 AND 7
       pstg 2
SS 9   HINDERED
       pstg 729
SS 10  HIGHLY
       pstg 3675
SS 11  9 AND 10
       pstg 27
SS 12  7 AND 11
       no match
SS 12  HIS
SS 12  PRI$
       3 OR 7                                           prompt (note 115)
       pstg 53
SS 13  PRT OFFLINE
```

APPENDIX F

SEARCHER'S COMMENTS

EXPERIENCED SEARCHER A

GENERAL COMMENTS

Search #1. Looks easy. Used Index Guide to get Registry Numbers.

Search #2. Has not yet solved the problem of how to search "in-water" topics. Since he was unsure of "salt water," tried it without salt.

Search #3. This topic is biochemistry which he knows nothing about. With good citations, he would go through Science Citation Index. Also, he would use an author approach since it is dealing with polymers. Did some offline preparation.

Search #4. Said he would not normally perform this search without the patron present. Requires too much guesswork about what the person wants. Thought of limiting this search by methods but since requestor indicated a comprehensive search, he decided to give him all of them.

Had asked what command cleared the system but before I could answer "ERASEALL," he had looked it up in his notes.

Does not like the multimeanings message.

SPECIFIC COMMENTS (see Appendix E)

Search #1

Note 1 Was sure the requestor wanted SS 5. Not so sure about SS 3.

Search #2

Note 33 These are the hot ones. Doesn't know if he should limit it to that. If requestor were here he would not have restricted it to salt water media since he doesn't know how to search it effectively. That is, he would not have limited it to that unsatisfactory approach. Pursues it without salt but it doesn't help.

Search #3

Note 68 "That's dirty pool." Apparently someone has written an encyclopedia article on just this topic and it's not properly indexed so the searcher can't build on it. "That's why CA does not have adequate indexing."

Note 69 Knows these 24 are good citations. Wonders how to get the rest.

Search #4

Note 90 Was thinking of limiting the search by methods but since the person wanted a comprehensive search, he decided to give him all of these citations.

EXPERIENCED SEARCHER B

GENERAL COMMENTS

Prefers to do a partial search, then get feedback from the requestor and define the search further rather than trying to anticipate a final search without requestor input. Does as much work as possible on a search prior to going online. Very money conscious, even for this test. The most concerned about time online of all participants.

Search #1. Does not like this topic - way out of anything he knows about. Would have looked up Abramovich article to help her develop the topic. Used Index Guide to look up Registry Numbers.

Search #2. Does not like to use Chemdex online. Would have looked up CO registry number manually under normal circumstances.

Search #3. Felt this to be a very broad search. In a normal situation, he would want to talk more with the patron, to get more of a definition of what he's talking about, does he expect to find a lot, is he using correct terminology, etc.

Would tell the person to plan on spending a lot of money or possibly approach by author.

Used Index Guide to help formulate the search.

At the end of the search, he said he would give those results to the patron as a starting point for more search development.

Search #4. Patron does not specify types of alcohol - would ask him about this. Says he prefers to do a broad search initially so the patron can throw out or narrow from them. Would give him the 14 postings, then tell him over 200 others available. Would have wanted further clarification.

SPECIFIC COMMENTS

Search #2

Note 34 Does not like to use CHEMDEX or CHEMNAME files online. Prefers to do this kind of preparation offline.

Search #3

Note 70 Needed help with how to print citations since he does not normally search SDC.

Search #4

Note 91 Discusses search procedure, preferring a broad approach to cover everything, then let the patron weed out irrelevant items of narrow topic more.

Experienced Searcher B
Specific Comments - Continued

Search #4

Note 92 Would let requestor look at first 50-100, then see how he might want to narrow topic. Proceeded to narrow because of project limitations.

Note 93 Would give him these 14 postings then tell him over 200 others available.

EXPERIENCED SEARCHER C

GENERAL COMMENTS

This searcher works for Chemical Abstracts Service. Like the others, he was free to use as much time as the others within the limits of an afternoon. Interested in having him "exploit" the database and SDC capabilities rather than be cost effective. While this was the same situation with others, he had less qualms about finding exactly what was in CA on that topic, even if topic poor. His ability to use the offline search aids was keen and he relied heavily on these for reference. He also knew the file so well that he could track down exceptions that even other experienced searchers would miss.

He said searches 1 and 3 were rough because he knew CA indexing policy on these was exceptional.

Search #1. Would probably go to the printed tool first because he suspects the substances are not listed in Chemdex yet. Would look for coordination compound for ligand entry, get registry number, then search online.

Used Index Guide extensively for preparation.

Went to General Subject Headings for electron exchange reactions and electron exchangers. Wanted to see what kinds of things are indexed under that heading. Suspects an online search will yield the same results.
Uses General Subject Headings too - open as reference while searching online. Gave up on controlled vocabulary - used natural language to get electron transfer which he said would pick up controlled vocabulary too.
Says CA searchers often fall back on natural language searching.

Search #2. Used Index Guide to find registry number for CO and CO_2. Said he knew it would be listed in the cross reference under carbon oxide. In evaluating citations, concluded they have nothing to do with what patron wants.

"Once I throw salt in, I'm in trouble." Many irrelevant citations, didn't like any of them repeatedly tries new strategies.
"Do you know if the emphasis is biological?" (I don't know.) I think he was considering searching by biol. section.

Search #3. Doesn't just refer to his notes while searching, also makes use of search request on SS4 where he got 900 postings. He asked for the Subject Coverage Manual - I should have had one for him to use - would like to get rid of material on inorganic polymers - can't do that without the subject coverage manual or reviewing all 900, if that's too many, would look at the last 79.

Says it is a difficult area - knows CA has a strange indexing policy on substrates.

EXPERIENCED SEARCHER C

General Comments - Continued

Search #4. Both Index Guide and General Subject Headings open and extensively used.

Not sure if he'll need methods indicated (by search requestor) but he might so he's looking them up in the Index Guide. In IG under infrared structure, he sees bond headings so he checks General Subject Headings under hydrogen bond. Would look for everything connected with pentamine cobalt in dictionary, legands, and combine with electron transfer to be really comprehensive.

Wanted to try author approach but not working.

Can't get rid of alcohol amine - anything to cut it would also get rid of relevant citations. Tried to take out amine term but reluctant.

"Thiazole has me puzzled - not sure what they mean."

SPECIFIC COMMENTS

Search #1.
Note 2. "That I don't understand." Used Index Guide to see where he made a mistake and corrected.

Search #2.
Note 35. Says he always forgets last parenthesis.

Note 36. Searched registry number with a qualifier.

SEMI-EXPERIENCED SEARCHER E

GENERAL COMMENTS

Said it was hard to keep up with changes in searching services. Usually uses the key word list to formulate search terms. Did not know how to search by author. Had not used Chemdex file before. Was not clear on the difference between the Index Guide and General Subject Headings. Used IG as if it were GSH until I explained the difference.

Search #1. Did not feel search #1 was well written.

Search #3. This searcher also wrote search #3. He said he was most definitely interested in "everything there is."

SPECIFIC COMMENTS

Search #1.

Note 4. Prompted all on SS 1.

Note 5. Needed help with number form on SS 2.

Note 6. Searching form of cobalt (3+) was a problem. When we found citations with it, he felt it confusing that the same citation listed it as both cobalt (3+) and cobalt (III).

Note 7. Having problems keeping track of search so I told him about the HISTORY command. He liked it a lot (new to him).

Note 8. Needed help remembering how to use logical operators. Asked for help. I suggested he print out SS 7.

Search #2.

Note 37, 38. Told him to try searching with AND.

Note 39. Suggested he restructure this since he used OR and AND in the same search statement.

Note 40. Reminded him to check the search request for the number of articles desired.

SEMI-EXPERIENCED SEARCHER F

GENERAL COMMENTS

Always wanted to learn about string search. Hoped I would show him when we were done. Never used Index Guide before to prepare a search. Hasn't searched in years (he helps students design searches [presearch]). Librarian then runs them for them.

Learned about the neighbor command a couple of days ago. Liked SDC display at truncation. Likes seeing terms. Uses word frequency microfiche.

I reviewed Index Guide and General Subject Headings with him - he does not emphasize when teaching his class online searching. However, the students must first search through the printed tool so they are familiar with the General Subject Headings.

Normally makes use of the microfishe list of terms but because of time, he'll do it online. He did not know that control vocabulary can be two words not linked with Boolean operators.

Search #1. Tried to look up pentammine in IG. Could not find the term. Says it should be spelled with two m's. His guess is that the researcher doesn't want articles on just the substance he mentions, but related substances as well, so he doen't want to restrict the search to pentammine cobalt group.

Search #4. Wanted to look up carbon 13 in the microfiche but not enough time. Decided to do it online.

SPECIFIC COMMENTS

Search #1.

Note 9. "Distrubing." - only 8 postings for SS 5.

Note 10. As he struggled to reconstruct search, I suggested HISTORY command.

Note 11. I helped him properly structure author search statements.

Search #2.

Note 41. He asked how to start a line over. I prompted $.

Note 42. Needed some assistance getting registry numbers.

Note 43. With only 29 postings his temptation would be to give them all to the patron.

I suggested he print a few to see if they were on the topic.

Note 44. Helped again with $.

Note 45. "That blows the whole thing away - unbelievable there's no match."

Semi-experienced Searcher F
Specific Comments - Continued

Search #3.

Note 71. Needed some assistance restructuring polymer-bound.

Note 72. - "That's everthing." Decided to play around a bit more.

Note 73. "Let's try another tack here. This is a place where I could have used clusters (explicit nesting)."

Note 74. Prompted him on use of colon in author searching.

Note 75. "I'm not sure I've got that name spelled right." Was also forgetting space after comma in author form but I was not watching to prompt him about it and he just assumed there were no hits anyway.

Search #4.

Note 94. "How about that, that's not going to get me anything. Back to square 1."

Note 95. That's better (13 postings)."

Note 96. "I just can't resist that. If I only get one posting, I've just got to see it!"

Note 97. Since the patron wanted a comprehensive search, he would give him these 74.

SEMI-EXPERIENCED SEARCHER G

GENERAL COMMENTS

This searcher had done some searching many years ago. Now if he needs a search done, he gives it to someone else to run. I assumed his background was stronger than it is and therefore may have not given him the appropriate introduction to the project. Also, there were some line problems and ORBIT often received messages with squiggles. It appears the testee did not try to key these terms in again; did not realize his messages were being read incorrectly.

Basically, this searcher took a manual approach to searching which resulted in too narrow a search strategy. He does not seem to start with a broad enough base to perform subject searches. He used the General Subject Headings, Index Guide, and even looked up some of the material listed on the search forms. His pretest notes were extensive, if too specific for affective online searching.

Search #1. He emphasized the importance of doing a manual search. When done, said he would need to rethink approach and try again later.

Search #2. Considered this a fairly straightforward search. Requestor does not specify whether he wants salt water or sea water. None of his approaches yielded relevant articles. (Happened several times with other participants on search #2.)

Search #3. Said that since the requestor wanted polymer reagents, he would approach the topic from Engineering Index first. Would also suggest Index to Encyclopedia of Polymers. He had looked in CA under "polystyrene" but there were at least three pages.

Search #4. Identified some highly hindered alcohols from memory and tried to track down their registry numbers before going online. Also meant to search by online section number 22 but forgot.

Again, I would like to emphasize that the poor results of this searcher were due primarily to my improper assessment of his familiarity with online systems prior to testing. This was compounded by line problems that I did not notice until looking over the results after the test was over. However, I must also say that a manual approach is not appropriate to online searching as this set of searches clearly illustrates.

SPECIFIC COMMENTS

Search #1.

Note 12. He reemphasized preference for doing a manual search first.

Note 13. Helped him set up this statement.

Note 14. Would give him that article, then talk about topic.

Semi-experienced Search G
Specific Comments - Continued

Search #2.

Note 46. I suggested he double check registry number. Noticed later he had forgotten /RN.

Note 47. Used "water" because he didn't expect many postings. Said the process was not well developed yet.

Search #3.

Note 76. Wonders if he should use styrene or polystyrene.

Search #4.

Note 99. Did not believe the postings for "hydrogen bonding." I suggested he check Index Guide. He said he would have prepared better under different circumstances.

Note 100. "I could have just printed the title."

Note 101. Would give the patron these two and then talk with the patron about the topic.

SEMI-EXPERIENCED SEARCHER H

GENERAL COMMENTS

This searcher does a small amount of searching for himself and others. He has a cue card of commands and the word frequency list on fische. Said the use of the $ to start a line over was a new and useful piece of information (picked up from AV presentation). I told him to do this and other searches as he would normally. The only major difference was probably that since it was for this project, he knew he needn't be as concerned about money. In fact, he and Semi-experienced Searchers E and F took the approach that the test was a chance for them to gain more experience online. Quite a strong tendency to print citations online.

Search #1. Doubted seriously if he would find 25-35 articles on this topic.

Search #2. No feel for this topic at all. Could get 2 or 200 postings. Does not like SDC prompt that asks if he wants to continue printing out citations.

Search #3. Looked up "pyridoxal" in the Merck Index. Never uses history command but reals in the paper often to check.

At conclusion of search said that he would tell requestor #3 that the literature on peptides is voluminous, that he should start with some books on it which he should be familiar with and if he isn't, he, searcher H, would recommend some. In short, he felt the search too broad. This was the first time he'd ever used exclusion (AND NOT peptides).

SPECIFIC COMMENTS

Search #1.

Note 15. "Oh dear, that can't be right (only one posting for pentamminecobalt).

Note 16. "That's exactly what he wants."

Note 17. "False drops. The 5 printed out are not all that relevant."

Note 18. "Probably good background - only one that is really right on target."

Note 19.

Note 20. Gave assistance with using AND.

Search #2.

Note 48. Can't believe "carbon monoxide" not listed.

Note 49. Does not believe CO2 posting either.

Note 50. Only one paper directly applicable.

Semi-experienced Searcher H
Specific Comments - Continued

Search #2.

Note 51. These 20 are probably good background even though in the field of engineering and the requestor is an oceanographer. Could have done without prompt asking him if I wanted to continue printing citations.

Search #3.

Note 77. "I'm getting nowhere here." Never uses HISTORY command but often reels in paper to check earlier input.

Note 78. "You've got to be kidding (no match)."

Search #4.

Note 102. This searcher had printed these out online and would have given print to requestor. Automatically reviewed printout and crossed off not relevant citations.

Note 103. Total set would include online and these offline citations.

NOVICE J

GENERAL COMMENTS

Said he would like to create subset of Journals to search. Required CODENS which we didn't have access to.

Had not read handouts sent prior to testing, looked them over at my suggestion. Found system too imposing to search without assistance. That is, despite keen interest regarded it as an imposition on his time if expected to figure it out for himself.

Went on system to play around. Explained basic mechanics like operators. Said was very familiar with CA General Subject Index (trained in Chemical bibliography at Oklahoma).

Said he felt there were too many searches, that he would much prefer doing one thoroughly. Throws experiment off balance because he would normally have done a great deal of preparation.

Chemdex file not available today.

Looked over search requests. Did not like #3. Says way too general i.e. literature survey on polymer chemistry. Would send it back and try to tie him down. Decided he wants review articles to help define the topic further.

Would probably start off with Journal approach if CODENS available:
Journal of American Chemistry Society
Journal of Organic Chemistry
Journal of Inorganic Chemistry (for #1)
Journal of Physical Chemistry

Said he would do more preparation on 1, 2 and 3 before searching. Liked #4 the best and felt he would let stand, felt he would find information on it as is.

Search #1. (Observation: person who would normally use indexes for preparation is not using them when faced with new line system. I reminded him of indexes as a source of contr.. terms. Did not care to use them.)

Does not think to ask me for help with vocabulary development since he considers chmistry his field.

Search #2. Asked if there was a set way to get review articles. I told him it was the same as any other topic i.e. review AND. (How to search for review articles would make a good canned search for prompting system.)

Asked how to formulate SS1. I told him any terms he could think of that would go with a review article, like history, etc. He acknowledged but didn't act on it in SS1. Seems reluctant to search same concept with different terms.

NOVICE J

General Comments - Continued

Search #3. Said once more he felt the search request was way too general. Satisfied with results given quality of search request.

Search #4. Feels the most confident about his ability to do a good search on this one. SS1 - "Than can't be." Turned to GSI to check term. Figured out the term must be hydrogen bond instead of hydrogen bonding.

SS5 - Said what he'd retrieved wasn't what the person wanted. I asked him why. He said why and I suggested he search the topic he was defining for me orally.

Does not consider 185 postings unreasonable given the topic.

NOVICE K

GENERAL COMMENTS

Went through an explanation of searching, the Index Guide etc. Went online to give him an idea of how system worked - searched "mass spectroscopy of dibenzoyl diimides."

Looked in Chemdex for RN and CAS 77, CAS 72-76 to give him "flavor" of how system works. He said he felt he understood basically how the system worked - thought he'd need help with commands though.

NOVICE L

GENERAL COMMENTS

Saw AV, read over handouts. Since he was local, he has been able to take more time to prepare. Studied the materials, the tools. When I asked him if he had any questions, he said he found the "mechanics very confusing." Asked some questions which lead to a review of:

continue on the next line
the print commands and what they would give you
an explanation of registry numbers
CA policy regarding RN's
content of a CHEMDEX record etc.
can use as many terms as you like
meaning of slash, then search field initials

Once we started searching, it was obvious the difference between controlled vocab. and free text was not clear, if not in definition then in use. I felt an oral introduction and leading him through a practice search would have helped. Also, he didn't really seem to understand what a record was, or the relation between the search statements and a record, or between one search statement and another. In short, I feel he would have benefited greatly from more of an introduction. It was cumbersome to try to cover this material adequately while on line. I did not want to do this, but I did make mental note that he needed more explanation, otherwise he wouldn't keep trying to put in terms without an AND operator, wouldn't drastically limit his searches at the beginning with his knowledge that carbon monoxide, for instance would retrieve too many postings. Fundamental understanding of the nature of the relationship between terms and record needed.

His concluding remarks indicated that he felt that despite how closely he read handouts, etc., it was necessary to be lead through a search to understand. Also, it was apparent that computer search demanded a different approach and way of thinking than a manual approach.

I felt his understanding of the topics and the level at which to approach the searches was excellent but he felt the mechanics and basic understanding of searching a database were too much to conquer without training.

The session was essentially a training session and he left with a much better understanding of the system even though he had watched others search before.

Search #1. Found it necessary to lead him through the search even though his concept development was good. Overall, I feel he understood quickly but help was necessary. I felt not enough explanation of searching preceeded session, that is, what a record is, what postings are, how to develop vocabulary, etc.

Search #2. Loses track of meaning represented by search statements. Decided he couldn't find anything on this one.

NOVICE M

GENERAL COMMENTS

After reading handout and seeing AV, we talked about searching. He asked if there were any advantages to starting broad and then narrowing search or vice versa.

We ran a practice search.

I have started out with all novices to try to get them to just sit down and search but the reactions to this have ranged from mild indignation to a dumb stare. As a result, it has turned into a tutorial anytime they "blank" out which is often until around the third search. At this point, they begin to enter the "semi-experienced" category. Testing the novices in the area has also changed the time demands. Especially true of novice who could have taken a whole day to run the test. Our "testees" have not had this kind of time to give us. However, when here locally they have had an hour here, and there. As a result, the testing has been broken up if necessary for their convenience. This has meant an introduction session and a testing session. They have taken the search requests away with them after the introduction. I have asked all who have done this to make note of any outside sources consulted.

His opinions of the searches (before searching).

#1. Confusing over the way the topic is presented. Felt the title was a much better description of the topic than the paragraph. Paragraph is confusing because it is not straightforward enough, especially if someone doesn't already know the subject. Things often come to a standstill once online.

#2. Difficulty getting beyond poor English. Problem seems straightforward enough.

#3. The searcher says he's interested in polymers too. Tremendously broad topic. At first, he thought the requestor didn't know what he wanted, then decided he might want a broad search before narrowing the topic. Felt the need to talk with search requestor.

#4. Pretty good project. Fairly straightforward. Thought it the best request. Has done some research on the topic himself.

Asked for an explanation of search guides. I explained the Index Guide and Subject Heading. He used IG after this to prepare searches. He couldn't believe there wasn't a registry number for hydrogen bond. I explained that there wouldn't be, that RN's are only for specific discrete chemical substances.

APPENDIX G: EXPERIENCED SEARCHER D

Experienced Searcher D's approach was so distinct that it is not possible to compare him with the others. For one thing, he uses an intelligent terminal with fairly sophisticated capabilities. This alters his approach to searching, and the way results were recorded for this project. This appendix includes only the final seach histories. There is a great volume of data on this searcher's style but but it is too much to include in this report.

Please contact Maureen Corcoran if you would like to examine the raw data. Also, the searches were run on CAS77 instead of CAS7276. After we caught this mistake, some were redone for reference but the CAS77 searches were his first attempt. Since his style includes discussing his search strategy instead of end results, it is not possible to match final bibliographies with others. See main body of report for further discussion.

SEARCH #1

Final Logic Used on CAS77

SS 1: ALL METHYL:PYRIDIN: (536)
SS 2: ALL PENTA:AMMINE: (116)
SS 3: ALL METHYL:PYRID:ONE: (46)
SS 4: ALL FERRICYANIDE: (339)
SS 5: ELECTRON AND (TRANSFER OR EXCHANGE) OR OXIDN AND REDN OR REDOX (10456)
SS 6: 5 AND ALL REACTION# OR 5 AND ALL KINETIC# OR 5 AND ALL MECHANISM# (6414)
SS 7: COBALT (15016)
SS 8: COBALT AND III (1367)
SS 9: 6 AND (NICKEL OR IRON OR FERROUS OR FERRIC OR FERRYL OR TRANSITION OR 7) (885)
SS 10: ALL PENTA:AMMINE:COBALT: OR 2 AND 7 (64)
SS 11: 10 AND 1 (1)
SS 12: ALL TAUBE, H:/AU (32) ← known author
SS 13: 5 AND 12 (10) } ← author's relevant hits
SS 14: 12 AND 5 AND 6 (10) }
SS 15: 1 AND 2 AND 7 (1) ←
SS 16: 3 AND 5 (3) ← wanted product from REDOX
SS 17: 16 AND NOT 15 (3)
SS 18: 3 AND 1 (12) ← product from starting materials
SS 19: 18 AND NOT (15 OR 16) (12)
SS 20: 10 AND 9 (13)
SS 21: 5 AND 6 (6414) ← Redox reaction general
SS 22: 21 AND 9 (885) ← Redox reaction using related transition metals
SS 23: 22 AND 10 (13) ← Pentaammine cobalt redox reaction using transition metals.

SEARCH #2

SS 1: CO OR CARBON AND MONOXIDE OR 630-08-0/RN (9858)
SS 2: CO2 OR CARBON AND DIOXIDE OR 124-38-9/RN (11064)
SS 3: 1 AND 2 (1701)
SS 4: 3 AND (OXDN OR OXIDATION) (136)
SS 5: 1 AND (WATER OR SEAR OR OCEAN OR ALL AQUA:) (511)
SS 6: 3 AND 5 (132)
SS 7: 1 AND (ALL TRANSFER: OR EQUIL OR ALL EQUILIBRI:) (330)
SS 8: 1 AND (ALL BACTERIA: OR ALGAE) (39)
SS 9: 4 AND 5 (4)
SS 10: 7 AND 3 (85)
SS 11: 8 AND 3 (5)
SS 12: 1 AND (ALL SEC10:/CC OR ALL SEC11:/CC OR ALL SEC61:/CC) (214)
SS 13: 1 AND 12 (214)
SS 14: 3 AND 12 (25)

(Continued next page)

SEARCH #2 - Continued

SS 15: 5 AND 12 (27)
SS 16: 6 AND 12 (4)
SS 17: 7 AND 12 (4)
SS 18: 8 AND 12 (29)
SS 19: 11 AND 12 (4) CO ; CO2 ; ALGAE ; SEC } ← targets
SS 20: 18 AND NOT 19 (25) CO ; ALGAE ; SEC }
SS 21: 17 AND NOT (18 OR 19) (4) CO ; EQUIL ; SEC
SS 22: 16 AND NOT (17 OR 18 OR 19) (3) CO ; CO2 ; WATER ; SEC } ← targets
SS 23: 15 AND NOT (16 OR 17 OR 18 OR 19) (20) CO ; WATER ; SEC
SS 24: 14 AND NOT (15 OR 16 OR 17 OR 18 OR 19) (18) CO ; CO2 ; SEC } ← samplings
SS 25: 13 AND NOT (14 OR 15 OR 16 OR 17 OR 18 OR 19) (140) CO ; SEC
SS 26: 25 AND NOT (SMOKE OR SMOKING OR ALL CIGARETT+ OR TOBACCO) (116) CO ; SEC

SEARCH #3

SS 1: SOLID AND PHASE AND SYNTHESIS (479)
SS 2: POLYMER AND BIOCHEMICAL (11)

SEARCH #4

SS 1: HYDROGEN AND ALL BOND: (3858)
SS 2: 1 AND (ALL BACKER, A:/AU OR ALL RAO, C.:/AU OR ALL BERNAL, J:/AU OR ALL LIPPINCOTT, E:/AU OR ALL POPLE, J:/AU OR ALL HANNA, M:/AU OR ALL MCCLELLAN, A:/AU OR ALL MURTHY, A:/AU) (4)
SS 3: 1 AND NOT 2 (3854)
SS 4: 3 AND (ALL MONOMER+ OR ALL DIMER_ OR ALL SEC35:/CC) (235)
SS 5: 4 AND ALL HINDER: (1)
SS 6: 4 AND (ALL STRENGTH: OR ALL STRONG:) (5)
SS 7: 4 AND NOT 6 (230)
SS 8: 7 AND (ALL ALSC OR ALL ALCOHOL:) (10)
SS 9: 7 AND ALL HYDROXYL+ AND NOT 8 (9)
SS 10: 7 AND NOT (8 OR 9) (211)
SS 11: 10 AND ANALYSIS (3)
SS 12: 10 AND PROPERTIES (22)
SS 13: 10 AND REACTIONS (29)
SS 14: 10 AND (NMR OR IR OR HEAT OR 11) (75)
SS 15: 14 AND NOT (8 OR 9) (75)
SS 16: 10 AND NOT (8 OR 9 OR 14 OR 6) (136)
SS 17: 16 AND 12 (14)
SS 18: 1 AND (ALCS OR ALL ALCOHOL: OR ALL HYDROXYL+ (360)
SS 19: 18 AND ALL HINDER: (2)

EXPERIENCED SEARCHER D

GENERAL COMMENTS

These comments taken from letters.

Search #1. Here are my notes on Question 1. I spent about three hours (off and on, among the usual business interruptions) plus about one hour of on-line time. I am not at all satisfied with the performance, but it does illustrate the problem of not having direct access to the requestor.

I made the erroneous first assumption that the REDOX synthesis of methyl-pyridone via a cobalt transition metal was well known. I entered the logic via Orbit in SAVE (ss 1 - 8 of INITIAL TRY) only to find no hits in the SS 4 and 5. I tried to resolve the problem on-line, but eventually admitted that I need to restructor the approach since I was not going to find the specific technology wanted.

In this type of request, I would search only CAS77, and give the requestor the list of hits from the following search statement sets, asking him to review the CA abstracts and then come back to me for either modifying the CAS77 search or to apply the same logic to CAS7276 and Chem 7071 if needed:

SS 16 (3)	Methlpyridones and REDOX reactions
SS 18 (12)	Methylpyridones and Methylpyridines
SS 20 (13)	Pentaaminecobalt and transition metals; since no hits resulted in SS 23 and 20, the 13 hits of SS 20 probably do not relate to REDOX reactions.
SS 14 (10)	Author H. taube items on REDOX
SS 21 (885)	This set represents the general subject of REDOX reactions using related transition metals. A 20 hit sampling might be in order for the requestor.

I found no hits that included all of the specific concepts in the requestor's written description. Namely, Methylpyridone REDOX synthesis using pentammine cobalt complex produced no hits (SS 3 and 7, or 3 and 10).

The following is a list of questions that came to mind as I tried to interpret the requestor's written No. 1 Search Description. In my opinion, the search description is well done. But since it covers a subject area where I have little experience, I would have preferred to discuss the request before making the search:

Questions to ask the requestor--

1. Does the user want a "concept" search or a search specific to methyl pyrdinium salts, penta amine cobalt (111), N-methyl-pyridone, ferricyamide?

Search #1 - Continued

2. Is the user an expert in this field? If he is, I would discuss his subject interest to be sure.
   1. My interpretation of the request meets his objective.
   2. Appropriate terminology use in this subject field.
   3. Develop additional terms and concepts that aids definition and logic.

3. Does the user expect a large number of hits? Is this an active field of broad participation, or a very specific field of chemistry where only a few probable articles/ patents exist. If a large field, then a narrow search is appropriate; if a narrow field, it may be necessary to search broad concepts in the hope of finding those few relevant hits that may exist. Discussion with the user is necessary.

4. If the user is uncertain of this field of chemistry and how much literature is out there, I would normally develop search logic to sample specific and broad as two separate packages. His analysis of the results would aid term/ logic development if further searching is necessary-- including use of data bases other than CA.

5. Is the user interested in all CA literature, including patents?

6. Has the user made a preliminary manual search of the CA index to confirm appropriate CA terminology?

7. Can the user draw the chemical structure of materials involved (molecular formula)?

8. Is the work "induced" critical to the subject area?

9. Transition metals H asks "Chem Dich 4th edition, Page 68 =
   Fe, Co, Ni = Iron Cobalt, Nickle
   RU, RH, Pd
   OS, IR, PT

Experienced Searcher D
General Comments - Continued

Search #2. Here are the results of Search Two. The terminal record (scroll) labeled OK is the search logic and sampling of various sets that I would want the requestor to review before going further with the search. The original logic package may be of some use--it was run against your ID. Since I am finding it difficult to find uninterrupted time to run your searches, I repeated the "OK" run on my costs.

As I commented on Search One, I would normally review these type of search requests with the requestor before spending time to structure and run the search. The requestor appears to be asking several questions which need clarification of objective as well as terminology. Obviously the requestor needs to know the time limitations of the data bases. They only go back about ten years.

Finally, I would not limit this subject to Chemical Abstracts. I would try Enviroline,Pollution, Compendex, Oceanic and NTIS for a comprehensive try.

Search #3. I found the Search Three description sufficiently difficult to interpret as to make a trial search essentially worthless. The requestor presents a general subject, but it is not clear what type of terminology and search objective is involved. Therefore, I am returning this search with only a cursory trial search attached.

I need to either talk with the requestor of he needs to supply a clearer description of the subject area, associated terminology and useful articles. Likewise, the penmanship is such that I cannot be positive on word and author spellings.

Enclosed is a copy of our search request form which I find is reasonably directive to the user. Actually, few requestors use in initially, but I use it in my presearch consultation with them.

Experienced Searcher D
General Comments - Continued

Search #4. Enclosed are my results on Search Four. As noted previously, the requestor appears to be asking several questions. I normally would review the request with him before running the search. A five or ten minute phone call would probably suffice. This is no small matter since a clear understanding is required between requestor and searcher.

None of the search requests permitted clear understanding of the requestors' objective and subject specifications (terms). My conclusion is that either (1) the requestors have little experience in using written requests as the primary communication vehicle to an on-line searcher, or (2) the instructions by the NSF study to the requestors placed unfortunate restrictions on the requestors, or (3) the search description forms were not designed for effective communication to the on-line searcher.

However, I tried to interpret Search Four as a four-part request:

1. General subject about the role played by hydrogen bonding in monomers, dimers and high-polymers.
2. Strength characterization of the hydrogen bond as associated with monomers, etc.
3. Hydrogen bonding associated with alcohols, including those hindered.
4. Sets of hits (and citation sampling) involving analysis, properties and reactions as associated with hydrogen bonding.

The high on-line time is the result of excessive on-line printing at 30 cps. My normal practice is to print off-line those sets containing more than five or ten hits.

We are installing a 1200 band printer at one of our terminals which will make on-line printing more economically feasible--especially effective when only a portion of the full format is needed by the requestor.

As a side comment to my handling of the four search requests, work time priority and the pressure of company work played a significant role in my ability to concentrate on any one search. I quite naturally place top priority on meeting my company's demands. And there were circumstances that interfered with clear thinking and terminal performance. I state this not as an excuse, but a statement of facts affecting the operating atmosphere. I felt more comfortable running Search Four--just the opposite of the circumstances surrounding Searches One and Two.

My various notes to you are my personal reactions. I trust you will use these comments carefully as there is no intent to downgrade anyone. After all, my comments are only one point of view and are made with very little background on the NSF study.